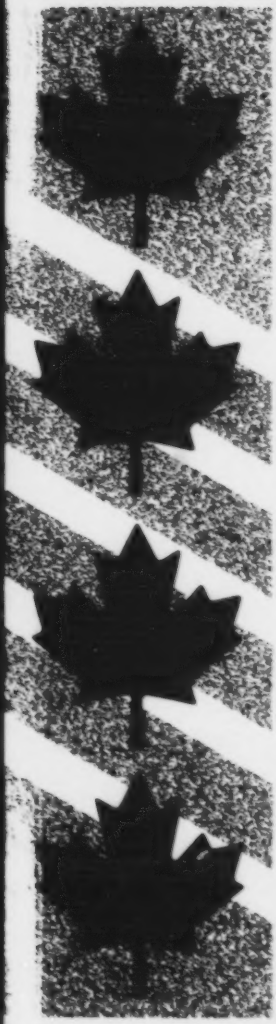

GETTING IT GREEN

Case Studies In Canadian Environmental Regulation

edited by
G. Bruce Doern

C.D. Howe Institute

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Foreword

With this book, the C.D. Howe Institute hopes to contribute to a practical understanding of the crucial Canadian and international debate on environmental problems. It follows an earlier exploratory study, *The Environmental Imperative: Market Approaches to the Greening of Canada*, which was published earlier this year, as well as two editions of *C.D. Howe Institute Commentary* that focused on recent federal government policy initiatives in this area.

Getting It Green is unique in that it examines several case studies in Canadian environmental regulation so as to draw out, in as practical a way as possible, the important but contentious issues involved in the greater use of market-oriented approaches. The Institute believed that a more specific look at practical pollution situations was required in order to show the necessary partnership between traditional regulation and these newer approaches.

The Institute's environmental research program is coordinated by G. Bruce Doern, Professor of Public Policy at the School of Public Administration, Carleton University, and a Scholar-in-Residence at the Institute. This study was copy edited and desktop published by Barry A. Norris.

As with all Institute publications, the conclusions presented here are the responsibility of the authors, and do not necessarily reflect the opinions of the Institute's members or Board of Directors.

Thomas E. Kierans
President

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Regulations and Market Approaches: *The Essential Environmental Partnership*

G. Bruce Doern

Getting It Green examines one of the key issues Canadians face in environmental policymaking and implementation. It looks carefully, through several case studies, as well as through published literature, at the relationships between the use of direct regulation and market approaches in achieving tougher environmental standards. A more concrete debate on these issues is essential, a point recognized by the federal government's 1990 Green Plan consultation paper.[1]

The central argument in the book is that, in the 1990s, market approaches must be utilized to a far greater extent as a complement to regulation. This is because market approaches — the use of tradable pollution permits, taxes, and charges — can achieve environmental goals as well as, or better than, an exclusive reliance on traditional regulation but at less overall social cost. This would then leave Canadians with additional resources, either for still further environmental progress or to realize other desirable policy goals.

At the outset, it is vital to stress that the task of implementing environmental policy is not a stark "either-or" choice between the role of government and the greater use of market approaches. This is why I refer to the relationship between the two sets of instruments

1 Canada, *A Framework for Discussion on the Environment* (Ottawa: Supply and Services, 1990).

of policy — regulation and market approaches — as the essential environmental partnership of the 1990s. It calls for a more sensible pairing of functions for those aspects of environmental policy that only the state can do well — setting standards in a democratic way and ensuring overall compliance — with those that only markets can do well — doing it at least cost, through the use of competitive technologies and price signals, by choices made at the firm or micro-organizational level.

This opening chapter deals first with some of the analytical imperatives in coming to grips with the implementation of environmental policy. Then, because the use of market approaches has been most widespread in the United States — although the dominant approach there has also been the traditional regulatory "command-and-control" method — the chapter reviews that country's experience in this area (the U.S. learning curve).[2] With this discussion as background, the book then begins to weave into the analysis the arguments and evidence that are more specifically cognizant of Canada's political economy.

To Canadianize the discussion, the first task is to probe the nature of this country's regulatory record. In Chapter 2, Tom Conway explores this generally by looking at whether in fact "command-and-control" is the appropriate label to apply to Canada's past regulatory record. Benoit Laplante takes this stocktaking exercise one step further in Chapter 3 by examining the two basic options that have been used *within* the confines of traditional regulation — namely, regulating performance versus regulating design standards. Each of the next four chapters then analyzes a particular case study. In Chapter 4, I look at nitrogen oxides and volatile organic compounds (NOx and VOCs); Douglas Smith examines policies to protect the ozone layer in Chapter 5; Donald Dewees reports on the regulation of sulphur dioxide in Ontario in Chapter 6; and Norman Bonsor offers his views on water pollution and the pulp and paper industry

2 See Paul R. Portney, ed., *Public Policies for Environmental Protection* (Washington, D.C.: Resources for the Future, 1990).

in Chapter 7. Three cases deal with air pollution problems and one with water. Each deals with past regulatory approaches and actual or potential uses of market approaches. Taxation, even though it has many of the attributes — such as flexibility and the ability to provide price signals — that Canada needs for effective environmental policy, has seldom been used as an environmental policy instrument. Nancy Olewiler examines this issue in the final chapter.

This introductory chapter both summarizes and critiques the total evidence brought to bear by the contributing authors. It concludes by suggesting some guidelines to foster the essential environmental partnership between regulations and market incentives.

Thinking Practically about Environmental Implementation

Anyone who wishes to think practically about how to implement environmental policy must do so on three analytical levels: symbolic and rhetorical politics; physical and technological parameters; and the role of public and private implementators.

Symbolic and Rhetorical Politics

The analytical level that I call "symbolic and rhetorical politics" deals with the nature and character of public debate about political values. A discussion of command-and-control versus market approaches easily evokes a form of universalism and stereotyping that is partly real but that is also several steps removed from the day-to-day world of actual implementation.[3] Thus, one of the main issues is the need to reduce the gap between rhetorical labels and reality. Command-and-control suggests a sense of firmness and certainty. The notion that "there ought to be a law" to prevent pollution attracts many adherents. The concept that tough rules ought to be applied to

3 See G. Bruce Doern, M. Prince, and G. McNaughton, *Living with Contradictions: Health and Safety Regulation in Ontario* (Toronto: Royal Commission on Asbestos, 1982).

everyone and that there should be no second-class environmental citizens is the stuff of 30-second bites on the national news.

Similarly, moral outrage is easily created by the notion that polluters can obtain permits to pollute and that firms can buy and sell them. Equal outrage can be expressed in mass-media-based politics if "national" standards are not met, implying that citizens in some parts of the country will be disadvantaged if lower regional standards — or no standards at all — apply.

There is indeed a moral basis to such outrage, and it is why environmental issues are so often at or near the top of public opinion polls.[4] Environmentalists usually oppose tradable pollution regimes because they recoil at having to place a value on ecological and human health. In their view, systems in which anyone has the right to pollute by purchasing a permit to do so are simply wrong. Environmental problems should be solved, they insist, through measures that appeal not to private interest but to a higher public interest.[5] Permits, they argue, seem to reward polluters that should be openly penalized. Many of these views were given further credibility by some of the early experiments in tradable permits, when the worst firms succeeded in gaining exemptions for themselves.

Business often expresses similar views. As economist Richard Lipsey points out, there are at least three reasons for such opposition. First, where market approaches involve a tax or charge, business may simply regard it as just another tax grab. Second, business people as individuals may feel the same sense of injustice as do other citizens if they pay more than others for their polluting activities. And third, they may feel a sense of outrage if their competitors continue to pollute while they do not.[6]

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4 See Robert Paehlke, *Environmentalism and the Future of Progressive Politics* (New Haven: Yale University Press, 1989).

5 Steven Kelman, "Economists and the Environmental Muddle," *Public Interest* 106 (1981).

6 Richard G. Lipsey, "Greening by Market or by Command," in G. Bruce Doern, ed., *The Environmental Imperative: Market Approaches to the Greening of Canada*, Policy Study 9 (Toronto: C.D. Howe Institute, 1990).

Fortunately, understanding of the complex tasks to be faced in environmental policy has improved somewhat. As detailed in the analysis of the NOx-VOCs case in Chapter 3, for example, the Canadian Environmental Network now supports experiments in the use of tradable permits. Nonetheless, symbolic excess is still far more prevalent than it ought to be, especially given the magnitude of the task at hand. The evidence increasingly suggests that command-and-control approaches do not produce equal environmental outcomes, no matter how tough-sounding the regulations are; indeed, they equally produce licenses to pollute.[7] Tradable permits, on the other hand, are often the exact opposite of licenses to pollute, in that they impose increasingly higher costs on the worst polluters.

At the same time, not just any tradable-permit system will work, nor will environmental taxes produce desirable outcomes regardless of how they are imposed or designed. All of this ought to be common sense; often it is not. Nonetheless, markets in many ways are the one element of environmental policy that have not been institutionalized. In short, markets are not defined and cannot play their efficiency role. Pollution flourishes in many domains precisely because of the failure to price environmental effects properly and to establish workable property rights.[8]

Public debate is always a short-hand summation of complex phenomena, so it cannot be condemned merely because it exaggerates. The trick is to reduce the gap between myth and reality so as to encourage the growth of political and economic wisdom.

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7 "Environmental Law Symposium," reported in *Yale Journal of Regulation* (1990), pp. 349–416.

8 See David Pearce, A. Markandya, and E. Barbier, *Blueprint for a Green Economy* (London: Earthscan, 1989); and Donald G. McFetridge, "The Economic Approach to Environmental Issues," in Doern, ed. *The Environmental Imperative*, pp. 84–109.

Physical and Technological Parameters: Bottom-Up Mapping

The first and necessary antidote to the excesses of environmental symbolism is an appreciation of the physical and technological parameters of the task at hand. This can be called "mapping from the bottom up" in order to contrast it with "top-down" policymaking. Such mapping must be visualized in several ways, because it is the ultimate reality of environmental policy. In a general sense, it simply involves realizing that the problems of air pollution problems are different from those of water pollution in terms of physical paths — the former typically traversing longer distances and the latter being more localized. The problems of toxic substances are different than both general air and water pollution.

At the micro level, bottom-up mapping also involves an appreciation that any particular hazard can traverse the full production cycle, from extraction from the ground to fabrication, from hinterland work place to urban work place, and from transportation within Canada to places abroad as products evolve into higher value-added forms. At several points along the production chain, governments already seek to intervene in the name of health, safety, and environmental values. But all of this is for one hazard or product, and there are literally thousands of them spread over regional, national, and international jurisdictions, and linked to hundreds of bodies of water, urban and rural land configurations, and air sheds. Little imagination is required, then, to realize that the task is enormous. It should be compellingly evident that the state cannot be everywhere in the thousands of sites where it is hoped environmental behavior will change. It clearly can never just command and control. The state must do some of these more coercive things, but it must let markets contribute to the solution. It must also bargain, cajole, persuade, induce, and cooperate or there is no hope of its being able to influence the kind of behavior that must change.

Last, but not least, in the vital mapping exercise are the intertwined scientific properties of various hazards and pollutants. In-

creasingly, the state and private firms and organizations must deal with families of pollutants, rather than with one hazard at a time. Scientific dispute also occurs over whether certain threshold levels of particular hazards or families of hazards should be allowed or whether zero-tolerance of exposure to or emissions of such pollutants is necessary.

Public versus Private Implementors

The serene and simple image of policy formulation is one of a cycle of steps. Problems are identified, alternatives explored, choices made, and action carried out to realize the objectives. The action phase is seen as the implementation stage, and is mentally equated with things that public officials carry out. In short, public officials are the implementors. This view also evokes a world of fairly dull, routine tasks, carried out more or less predictably.

This image is less and less applicable in many policy fields but especially so with respect to environmental policy, where a good case can be made that most of it must be implemented by private policy implementors. In other words, it requires tens of thousands of decisions and actions by members of corporations, as citizens and consumers. Serious public policy seeks to change human behavior in desirable ways over a sustained period of time. The points at which behavior must change are so numerous, as the previous section shows, that the task is impossible for public implementors alone, even if they are aided by especially vigilant and omnipresent environmental groups.

Indeed, far from being the dull, routine, bureaucratic plodder, the ideal environmental regulator-implementor would almost have to be superhuman, possessing levels of economic, financial, and ecological knowledge — not to mention the wisdom of Job — that would be truly heroic. In his chapter, Benoit Laplante graphically demonstrates this in an account of the firm-level production information that regulators must have and, of course, cannot ultimately acquire.

Thus, the third analytical level to appreciate is that environmental policy is, and must be, quintessentially a world of private market-based and community implementation. This does not mean that public implementors are not essential. Clearly, they are. But it does mean that public implementors must be involved in roles that only they can do well and that set overall directions for standards and compliance. They must leave the rest to markets.

The U.S. Experience with Tradable Permits

A significant body of literature now exists on the U.S. experience with economic approaches to environmental policy, particularly the use of tradable or marketable rights.[9] The brief review of the literature presented here is intended only to highlight this U.S. experience. But first, the essential features of market approaches need to be set out.

Tradable regimes begin with the central regulatory role of the state. It must set the basic desired level of emissions reductions that are consistent with air- or water-quality standards. The state must also enforce these limits through the imposition of penalties. In these two vital functions, tradable regimes are identical to those which use a command-and-control approach.

The difference in the two regimes is what occurs in between these two functions. Market-oriented approaches seek to reduce emissions most where it is least costly to do so. This results in overall costs that are lower than might arise with an across-the-board or more rigidly prescribed command-and-control approach.

The reason for this superior cost outcome lies in the different marginal-cost situations that different firms face to reduce each additional unit of pollution. In turn, these marginal-cost differences

9 See, for example, R.W. Hahn and G.L. Hester, "Where Did All the Markets Go? An Analysis of EPA's Emissions Trading Program," *Yale Journal on Regulation* 6 (1989): 109–153; and A. Atkinson and T. Tietenberg, "Market Failure in Incentive Based Regulation: The Case of Emissions Trading," Association of Environmental and Resource Economists Workshop, *Natural Resource Market Mechanisms Proceedings* (Madison, Wisc., June 1990).

arise because different firms have different product mixes, technologies, ages of plant and equipment, and so on. For example, if the marginal cost per ton of pollutant for company A is $500 and that for company B is $3,000, company A can accrue savings if it can sell its pollution rights to company B. If the average price of the pollution right were $2,000, then seller A could gain $2,000 (minus) $500, or $1,500. Buyer B could save $3,000 (minus) $2,000, or $1,000 per ton. The total savings would be $2,500 per ton. The goal of tradable regimes, then, is to establish a cap on total emissions within a geographic area and then allow the allocation of emissions to be determined through market choices made by those who know the microeconomic situation of the firm best: their private managers.

Thus, the further role of the state in market-oriented regimes is first to issue permits or quotas and then to organize a market for them. For the overall regime to be successful, all of the pieces have to fall into place, and states and markets must function in the knowledge of the legitimacy of both roles. The standards must be scientifically, technically, and democratically legitimate.[10] The enforcement must be effective and fair. The markets for permits must be workable and certain so that rights are clearly established. Geographic areas must be viable.

The U.S. experience with tradable permits reflects a mixed record of learning by doing, basically over the past ten years. Although command-and-control is still the dominant approach in the United States, various kinds of trading have been used. Initially, a form of "controlled trading" occurred, enabling the growth of such practices as "offsets", "netting", "bubbles", and "banking", each of which was designed to introduce flexibility (these terms are explained in subsequent chapters). The United States has gradually moved to other, more open, less controlled trading regimes — as in the case of lead in gasoline, chlorofluorocarbons (CFCs), and the current *Clean Air Act* provisions dealing with acid rain.

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10 G. Bruce Doern, *Canadian Environmental Policy: Why Process Is Almost Everything*, C.D. Howe Institute Commentary 19 (Toronto: C.D. Howe Institute 1990).

The early experience with controlled trading was mixed, to say the least. There were some cost savings, but the new system's rules were very complex, difficult to obtain consensus on, and subject to numerous changes, including court challenges. This meant considerable start-up problems in measuring credits and in determining how standards would be expressed — as rates? volumes? It also meant that property rights were insecure.

Analysts gave far higher marks to the programs on lead and CFCs, and the experience gained here became part of the learning curve for the provisions in the present *Clean Air Act*. Industry was initially skeptical about these programs, but its subsequent behavior proved quite supportive.[11] Widespread trading did occur, although it took time to develop, resulting in large savings without any harm to environmental goals. Major reductions in emissions occurred.

One summary of the U.S. experience draws attention to several points about the specific design of trading schemes. First, the details of these schemes matter a great deal. Issues such as how well the initial allocation is defined, who can trade with whom, barriers to trading, and ensuring that environmental goals are met are crucial to the political economy of design. Second, trading works best if integrated into the rules from the outset, rather than as an "add-on". Third, the starting points from which trading occurs must be clear. Fourth, trading works better if allocations can be defined in terms of quantities of emissions, not rates. And finally, early integration can ensure that trading is environmentally positive.[12]

The economic literature in the United States also notes that most of the trading that has taken place under the U.S. Environmental Protection Agency's program has been internal to the firm. This is still superior to no trading at all, but it falls far short of the ideal purposes of trading regimes. Again, the reasons for this more limited

11 See National Economic Research Associates, "Emissions Trading: An Overview of Concepts and Experience" (Paper presented to the NOx-VOCs Workshop on Flexible Mechanisms, Montreal, June 6–7, 1990).

12 Ibid.

success are attributed to the same array of factors cited above. Other studies also point to the fact that when interfirm trading does occur, it is largely bilateral — that is, it occurs between two parties at a time — thus reducing the potential for cost savings.[13]

In general, the U.S. experience suggests that the potential for cost savings from the use of tradable regimes is significant, and that agreed-on emissions reductions can be achieved from such a system. It also suggests that the realization of these gains involves a considerable political-economic learning curve and a recognition that specific design attributes are vital. While more such regimes are being built in from the outset of the rulemaking process, it must still be remembered that the U.S. environmental regulatory system as a whole is still very much one of command-and-control.

The Canadian Regulatory Approach

The first step in examining the extent to which the U.S. experience is relevant to Canada is to look at the Canadian regulatory approach to environmental implementation. Chapters 2 and 3, building on other published work,[14] supply a succinct analysis of Canada's traditional approaches.

While in some respects it is quite appropriate to call Canada's approach a command-and-control system in that it certainly is not market based, in other respects the command-and-control label is inadequate and inaccurate. Tom Conway's analysis in Chapter 2 shows that, until the passage in 1987 of the *Canadian Environmental Protection Act*, Canada's approach was often command but not necessarily control.

The pre-1987 system had three overall characteristics: a preference for technology-based setting of regulatory standards; a tendency to use negotiation and exhortation as a substitute for strict

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13 Atkinson and Tietenberg, "Market Failure in Incentive Based Regulation."

14 See, for example, K. Webb, *Pollution Control in Canada: The Regulatory Approach in the 1980s* (Ottawa: Law Reform Commission of Canada, 1988).

legal enforcement of standards; and the periodic use of spending incentives to facilitate industrial adjustment. After the passage of the new act, the second "c" in command-and-control began to receive a more credible recognition. It is also the case that Canada's approach to regulation has been closely modeled on U.S. experience, with the important caveat that the U.S. system has always been more litigious and its processes more open and democratic.

The federal Department of the Environment and provincial environmental agencies have enjoyed some success, but, as Conway points out, Environment Canada's inherent capacity was blunted from 1975 until the late 1980s by four dynamics. The first was an inability to establish and carry out rigorous compliance procedures. The second was a weakening through budget cuts of an already overtaxed scientific and investigative capacity. The third was the federal government's insecurity in its relations with the provinces and among its own departments. And finally, Environment Canada was itself primarily a technical department, possessing only limited economic and even, to some extent, legal literacy and analytical capacity. Directly or indirectly, all of these elements were indicators of the low position that environmental policy and implementation occupied on the political and economic agenda.

Benoit Laplante's analysis in Chapter 3 takes us in greater detail into an assessment of the two basic options that exist *within* the traditional command-and control-approach: to regulate *performance*, or to regulate *design standards*. In the former case, the regulator sets emissions levels but leaves the firm free to achieve these targets by any means it wishes. In the latter approach, the regulator specifies precisely the type of control technologies the firm must use.

Laplante focuses on the regulator's significant and inevitable lack of information — the same Achilles' heel, he argues, of policy enforcement — which allows polluters to manipulate the monitoring process to their own advantage. For these and related reasons, Laplante expresses the normal economist's preference for regulating performance rather than design standards.

But the second point that Laplante brings out is that regulating performance is certainly not in all cases the preferred option to regulating design standards. In situations where polluters are a small number of firms in an oligopolistic industry, the *social* cost of the emissions-abatement program may be lower under a design system despite the fact that the polluter's cost is lower under a performance standard. Thus, even within the nominal command-and-control arsenal, there are no universal solutions. What clearly emerges from Laplante's account of the applied use of such traditional regulatory concepts as "best available" and "best practicable technology" is that technology-driven command approaches are increasingly costly without any necessarily improved environmental results. At the same time, such approaches are still dominant in all Western countries and have resulted in some environmental progress. Accordingly, no serious advocate of market approaches envisages a total replacement of the old approach with the new. If market approaches have merit, they must be shown concretely to have practical value.

In general, Canada's experience suggests that the command-and-control label is only partially valid in environmental implementation. Therefore, one is not simply substituting in any simplistic way a "new" market approach for an "old" command-and-control regime. A determination of whether this is good or bad for the prospects of using market approaches must wait until the case studies have been examined.

Canadian Cases

Since there are no fully fledged Canadian cases in which tradable permits have been used, the ones assembled here must be considered as proxies. One cannot generalize too readily from these cases, but it is possible to use them to illustrate and probe. This is important at the current stage of the regulation-versus-incentives debate in Canada, because various interests involved in the debate need to see

concrete situations. Before discussing the four cases, however, it is useful to keep several points about them in mind.

Three of the cases deal with air pollution and only one with water pollution. As already mentioned, economic approaches in the form of tradable permits have been more prevalent in the area of air pollution. In only one case, NOx-VOCs, are proposals for tradable permits actually being advocated by some of the stakeholders. In the other three, the contributors to this study examine partial market approaches or advocate the use of such approaches for action that Canadian authorities might take in the 1990s.

The contributors' academic disciplines are also indicative of different focal points in the four cases. A political scientist examines the NOx-VOCs case, focusing as much on stakeholder consultation processes as on the substance of the case. Economists examine the other three cases, focusing primarily on efficiency and cost issues. In each case, however, the contributors set out a brief technical primer on the nature of the hazard or pollutant, the economic structure of the industry, and the role of international and comparative pressures and practices. The brief summaries below draw out only the main points germane to the central debate about the relationship between traditional regulation and the use of economic approaches. Each case should be read in detail to appreciate the full interplay among its technical, economic, and political variables.

The NOx-VOCs Case

The NOx-VOCs case deals with the current effort by the federal and provincial governments to develop a long-term, 15-year management plan for the regulation and reduction of nitrogen oxides and volatile organic compounds. The first draft of the proposed management plan advocated a wide array of traditional regulatory measures, but the stakeholder consultation process resulted in pressures and counter-proposals to adopt economic approaches, including tradable permits. Both hazards cause ground-level ozone problems, but the

industrial structures of the companies that produce and consume these hazards are very different and quite complex.

Chapter 4, in which this case is examined, draws attention to several issues the case brings out. It agrees with some of the critics of the proposed plan that there should be room for the use of tradable permits as a complement to traditional regulation. At the same time, it argues that, in this case, there is a danger that a permit system might become just an experimental add-on to the larger command-and-control package, rather than being integrated in the plan from the outset. As a result, the social costs will be far greater than they need to be. Indeed, the chapter shows that the goal of minimizing social cost should be far more explicitly stated in such exercises along with the goals of solving the environmental problem and meeting Canada's international obligations.

The NOx-VOCs case also highlights the dilemma that regulators face over the issue of single versus multiple hazards or families of hazards. It shows that, in principle, the more integrated and multi-hazard-based the pollution problem, the more likely that tradable permits and other incentive approaches will be needed.

Last, but far from least, the chapter brings out the vital importance of open and elaborate stakeholder consultation processes. The NOx-VOCs case may be exemplary in this respect. The chapter demonstrates that the stakeholder consultation process requires as much care and detailed commitment of resources as do the technical aspects of regulation.

The Ozone-Layer Case

In Chapter 5, Doug Smith focuses on the implementation of Canadian policies to protect the stratospheric ozone level. Much of the destruction of the ozone layer has been attributed to emissions of chlorofluorocarbons (CFCs) and halons. The control strategy is based on the Montreal Protocol of 1987, and its most important feature, in Smith's view, is that specific CFCs are not regulated individually. Rather, the decision to regulate separate overall consumption bas-

kets for all CFCs and halons was the first step that has allowed market forces to determine how the reductions would take place.

Cost-benefit analysis has also been used extensively in this case. Combined with the flexibility built into the overall regime, it has allowed companies to develop reduction approaches and technologies that appear to enable them to meet reduction targets more easily than was originally estimated. Thus, detailed controls have been eschewed and overall targets met at considerably lower costs.

Because the Montreal Protocol froze 1989 consumption at 1986 levels, this restriction essentially created a quota. In Canada, the right to produce or import CFCs and halons was allocated to producers and importers on the basis of their benchmark data for 1986. These quotas could have been auctioned, but, as Smith points out, individual firms were not mandated to achieve specific reductions. The mechanism for consumption reductions is the price system. Prices for CFCs have increased as a result of the freeze, squeezing out of the market those users for whom control costs are less than the costs of paying more for CFCs. Transferability of CFCs among users is thus quite complete. On the production side, however, Canada has limited transferability between the producers of CFCs and halons and between the CFC basket and the halon basket.

Thus, the structure of the industry, in this case with two main producers, does effect the degree to which further economic approaches might make sense. Smith is careful to stress that further transferability may be problematical. He argues nevertheless that further reductions or freezes in the 1990s should proceed in the same way. He shows why blunter policy instruments, such as a product ban, will not work.

The Sulphur-Dioxide Case

In Chapter 6, Don Dewees analyzes the regulation of sulphur dioxide in Ontario, especially in the context of the provincial Countdown Acid Rain program of the 1980s. Compared with the first two cases, the sulphur-dioxide case involves the somewhat simpler situation of a

single hazard with four companies — Ontario Hydro, INCO, Falconbridge, and Algoma Steel — accounting for over 83 percent of total manmade emissions.

Under the Countdown Acid Rain program, the Ontario Ministry of the Environment adopted a comprehensive set of regulations to reduce emissions, issuing separate ones — differing in emissions rates and timing, but otherwise similar in nature — for each of the four major corporate sources. These regulations marked a different approach from earlier periods, when the ministry was more concerned with specific local pollution and specific facilities.

Dewees notes immediately that this flexible, market-oriented feature makes Ontario's regulatory system quite different from that in the United States, where it is a novelty to treat even an entire plant as a single source as Ontario does. In addition, in the United States, quantity regulations specify limits in rates such as pounds of pollution per ton of product output. Ontario imposes quantity regulations specifying limits in tons per year, which allows easier trading.

Thus, in Dewees' view, in their basic institutional form Ontario's regulations are better suited for a possible trading regime. In terms of efficiency, however, the system still leaves much to be desired. Dewees argues that compliance costs — close to $3 billion in the 1990s — could be considerably reduced were the marginal costs of control to be equalized through the aid of a tradable emissions-rights program. He advocates that Ontario's regulations be amended so that any regulated source could purchase rights from another source in any year when they were not needed. If INCO, for example, could reduce emissions at a cost of $100 per ton, while it costs Ontario Hydro, say, $1,000 per ton, then every additional ton of reductions shifted from Ontario Hydro to INCO means a savings of $900.

Dewees acknowledges that with only four major sources, not many trades could be expected, but even a single trade or a few trades could save tens of millions of dollars. He also shows that there are several reasons in addition to those cited above why trading may work better in Ontario than in the United States. For one, there would be no need in Ontario for regulatory approval of every trade as often

happens in the United States. For another, a clear statement about the longevity of the rights — lasting until the end of the 1990s — should allay concerns that trading might compromise future bargaining with the Ministry of the Environment about emissions reductions.

Dewees concludes with the interesting observation that, unlike in the United States, there has been no trading of emissions rights in Canada, because the Canadian regulatory regimes have not involved the rigidities that gave rise to trading south of the border.

The Pulp-and-Paper-and-Water-Pollution Case

As the only water-pollution case in this volume, Norman Bonsor's analysis in Chapter 7 deserves special attention. He focuses on the pulp and paper industry for good reason: it is the largest single industrial discharger of water-borne pollutants in the country. Moreover, the history of regulation in this area is a consummate story of command-and-no-control and living proof of the pitfalls of both the information and political gaps that Laplante and Conway identify. It is also evidence that chief among the causes of the water-pollution problem is the failure to establish and enforce property rights.

Bonsor stresses throughout that most water pollution is more localized than air pollution. In the pulp and paper industry, it is even more highly localized, often in the locale of the classic Canadian hinterland-based "one-industry" town, and the impact on a receiving water's dissolved oxygen is usually limited to a few kilometers from the point of discharge.

Because of the lack of enforcement, political pressure has focused, not surprisingly, on coming down even harder on the pulp and paper industry, and the proposed federal regulations are very firmly in the command-and-control camp for politically understandable reasons. But Bonsor, while critical of the past record, argues that the planned federal approach will be unnecessarily costly. He notes that since the regulations are not based on the capacity of

individual receiving waters to absorb pollutants, they are thus likely to lead to some waters being overprotected and others underprotected. He further argues that it is technically possible to determine the amount of loading that any given receiving water can handle. This should allow an overall quota on the permissible loading to be set. One could then move away from placing technology-based limits on each polluter and concentrate instead on looking for total loadings. Each polluter could receive or purchase an initial quota, with quotas freely tradable.

Bonsor shows the average and marginal compliance costs of proposed regulations on the pulp and paper industry if the traditional approach is used. Over a 20-year period, the marginal cost to society is expected to be $4–5 billion (in 1990 dollars). And this is for a major exporting industry that is facing increased international competition. Given these costs, and given the widely varying marginal costs of firms, Bonsor favors a greater use of tradable permits.

The case study also shows, however, that a quota scheme in the pulp and paper industry runs into a major problem in that a single mill is often the only effluent source, which seriously limits the potential for trading permits. In these single-firm situations the result would be identical to that achieved by optimal regulation, since its quota would be set on the basis of the capacity of the receiving water. Bonsor briefly examines the options and/or complementary actions — such as effluent charges or taxes and other incentives — that might be used.

Overall, then, Bonsor is sympathetic to the use of tradable permits, especially given past failures and the prospect of huge future compliance costs. At the same time, he is more cautious than are the other contributors, mainly because of the different problems that water pollution presents in general and that the political economy of the Canadian pulp and paper industry presents in particular.

Taxation as a Market Approach

Even though a tax is obviously a government action, it also constitutes an important part of market approaches to environmental

implementation.[15] This is because a tax, if set and kept at the right level, can improve economic efficiency by internalizing the cost of pollution to the firm. It also leaves to the firm or individual the decision as to how to reduce pollution. In this dual sense, an environmental tax is an especially good tax and, as Nancy Olewiler shows in Chapter 8, a well-designed one is also likely to facilitate continuous innovation on anti-pollution technologies. This prospect is not high in traditional command-and-control approaches.

Olewiler also draws out the difficulties of setting and maintaining the right tax level and of handling the revenues gained. Setting the right level involves finding the right economic values for the pollution, a problem that exists for basic standards setting as well. Maintaining the right level is also a problem: as European experience with taxes and charges shows, it is difficult to maintain the real value of the pricing signal because of inflation.[16] Imposing the tax or charge might be politically achievable at first, but changing it frequently may be more difficult.

While Olewiler recognizes the revenue-generating potential of environmental taxes, she cautions against regarding them as fiscal gold mines for deficit-ridden finance ministers. She argues that both the economics and the politics of environmental taxation require that these revenues be specifically earmarked for environmental purposes. She shows that — logically, at least — a good environmental tax ought to yield large revenues in the first few years, but that they then should decline over time since their intent is to reduce pollution.

The foregoing economic case for environmental taxation is undoubtedly a sensible one, but the political pitfalls are significant. Canadian finance authorities are stout in their objections to the direct linkage of any tax with any specific expenditure fund. It has been done, however, and exceptions can be made. A more difficult

15 See Mark Pearson and S. Smith, *Taxation and Environmental Policy: Some Initial Evidence* (London: Institute for Fiscal Studies, 1990).

16 See H. Bressers, "The Role of Effluent Charges in Dutch Water Quality Policy," in P.B. Downing and K. Hanf, eds., *International Comparisons in Implementing Pollution Laws* (Boston: Kluwer Nijhoff, 1983).

problem in Canada is the basic distributive politics involved. For example, a carbon tax, depending on how it is set, could easily be portrayed as anti-Western Canada. Other specific environmental taxes could also produce difficult regional political issues.

Maintaining taxes at real rates of value can also be a problem. It is also not too early in the environmental tax debate to consider what the tax system might be like ten years from now, if, for instance, there was on average one new environmental tax imposed in each federal budget and equivalent numbers for each provincial budget. The temptation for finance ministers to impose many little, partially real, partially symbolic taxes to gain continuous credit for environmental initiatives may well be irresistible. One could then imagine pressure in 2000 for environmental tax reform to clean out and simplify the tax system, much as was said about other aspects of tax reform in the 1980s.[17]

Despite these dilemmas, a very good case can be made for the use of a few well-designed taxes and charges as a part of Canadian environmental implementation in the 1990s. These could be used on their own or as a complement to other policy instruments.

Conclusions and Prospects

Given the three levels of analysis traced above, and given both the U.S. experience and the Canadian proxy case studies, several conclusions emerge regarding the prospects for a new environmental partnership between regulation and market approaches.

Market approaches such as tradable permits and taxes and charges do offer a real prospect of implementing strong environmental policies at less overall social cost than can be achieved through an exclusive reliance on traditional regulation. This can be done without any losses in environmental effectiveness. Indeed, Canada

17 See Allan Maslove, "The Goods and Services Tax: Lessons from Tax Reform," in Katherine Graham, ed., *How Ottawa Spends: 1990–91* (Ottawa: Carleton University Press, 1990), pp. 27–48.

may be institutionally better suited than the United States to implement trading regimes, in part because the regulatory approach in this country been more flexible to start with. Ideologically, however, Canada may be further away from using such devices simply because there is a less ingrained appreciation of the value of markets in general in the Canadian political culture.

This means that it is even more important than ever that Canadians begin to see concrete uses of such measures so as to reduce the myriad gaps between myth and reality that attend environmental regulation. Moreover, there is no need to take a full decade to learn how to do it: even after taking into account institutional differences between the two countries, the U.S. experience ought to help compress Canada's learning curve. The Canadian compliance record and the Canadian cases also suggest some of the essential prerequisites for future success.

In designing viable, regulatory-market-approach partnerships, the first requisite step is to improve significantly the basic capacity of regulators to regulate intelligently — to demonstrate the ability of the regulatory process to handle the two functions that the state must carry out itself. Attention to the democratic setting of standards, as well as to final compliance, requires greatly expanded resources, openness, and capacity on the part of Environment Canada and its provincial counterparts. While the *Canadian Environmental Protection Act* provides a stronger federal base for this task, it will amount to little unless the department's technical and political-economic underpinnings are greatly strengthened.

Beyond this initial lesson for future success, other requirements are necessary to help make the use of tradable permits an essential complement to traditional regulation:

- tradable regimes ought to be integrated into regulatory programs from the outset;
- there must be a fairly simple and equitable system for allocating permits;
- there must be long-term contract-like commitments to ensure reasonable predictability and, hence, to ensure that trading

occurs from the outset because participants will know that there is an economic value in the permits; and

- the objectives of the regime ought to be clear, with that of minimizing social cost being as explicitly stated as the equally desirable environmental goals and standards.

Emphasis must also be placed on the basic institutional capacity of the particular regulatory bodies involved. They must have clear legal authority to engage in establishing tradable regimes — a problem in some Canadian statutes— and they must have excellent technical and economic capacity and the patience to build in carefully designed stakeholder consultation processes along the lines being carried out in the NOx-VOCs case.

As for environmental taxes, Canada must use this valuable policy tool as a key part of environmental implementation in the 1990s. Such taxes will only gain political acceptance, however, if they are well designed with pollution values clearly stated and revenues earmarked for designated environmental spending. Special care must be taken to avoid a binge of small, quasi-symbolic tax measures that, by 2000, might grow into an environmental tax jungle.

In short, the fusion of traditional regulation with market approaches requires passing three fundamental ecological, economic, and political tests. The first implies a technical and human appreciation of the physical parameters of environmental problems. The second involves a practical realization that Canada cannot enjoy environmental success without being far more conscious of the efficiency with which it regulates. The third requires that the vital remaining command-and-control components underpinning the system be openly and demonstrably legitimate and effective.

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2 Taking Stock of the Traditional Regulatory Approach

Tom Conway

This chapter examines the regulatory approach to environmental issues that has been taken over the past two decades.[1] The goal is to contribute to the stock of knowledge about Canada's environmental regulatory habits to date.

The chapter begins by describing the traditional regulatory approach in Canada, and asks to what extent it is appropriately labeled "command-and-control". Then, the chapter looks at the federal Department of the Environment (DOE), briefly highlighting stages of its historical development and aspects of its inherent organizational strengths and weaknesses. This is followed by an outline of recent regulatory changes taking place within the department under the provisions of the *Canadian Environmental Protection*

1 The discussion in this chapter is taken from other ongoing historical research by the author. In the context of this research, several interviews were conducted with officials of Environment Canada. Their cooperation is much appreciated. Special thanks go to Ken Clark of Environment Canada for his generosity in making available the detailed findings of historical research he is conducting. Much of the second section of this chapter has been made possible by his efforts. His research will help fill a major gap in historical literature dealing with environmental policy. Appendix 1 to this chapter is constructed from documents provided by the department. The views of all the interviewees have been kept anonymous. The ideas in this chapter, in the final analysis, remain the responsibility of the author.

Act. The chapter concludes with overall observations on the continued importance of traditional regulatory standards setting as a necessary complement to market-oriented approaches.

"Taking stock" is a matter of great importance to Canadian environmental policy. University and other researchers who are now studying the field are struck by the paucity of literature and data. After more than 20 years of attempted action — and some notable progress — on the environment, we still know very little about the policy and implementation record. Data on monitoring, testing, enforcement, costs and benefits, natural stock, and so on, remains thin or, where available, extremely unreliable and user unfriendly.

This problem appears particularly severe when one accepts that the political landscape has changed and more action on the environment is inevitable and desirable. Yet, we do not have a sound base of knowledge about the nature and magnitude of Canada's unique problems, nor a reliable and effective way to assess how well we are doing.[2] Environmental problems are very diverse and our assessments of what constitutes a problem or what is an acceptable social risk often change. Because of this diversity and change, we require good data to inform our multiple decisions. The process of responding to environmental problems is not one choice but a series of interconnected choices over time and across specific circumstances.

Good information, along with legitimate, democratic decision-making, is essential to stable, effective, and efficient action on the environment. Conflict between stakeholder groups will only begin to be bridged on this foundation. We will need to select repeatedly from a mix of different approaches for the specific circumstances at hand. First, however, we need to characterize accurately what the traditional approach has been.

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2 See G. Bruce Doern, *Canadian Environmental Policy: Why Process Is Almost Everything*, C.D. Howe Commentary 19 (Toronto: C.D. Howe Institute, 1990).

The Traditional Regulatory Approach

A central characteristic of the recent discussions about environmental policy instruments has been to equate the traditional regulatory approach with the concept of "command-and-control".

This phrase conjures up images of devilish regulators setting rules and beating people into submission with no recourse to cost efficiency or right of appeal. Left unclear, more often than not, is the exact definition of the traditional regulatory approach. What exactly has Canada's approach been?

The traditional regulatory approach in Canada, as in the United States and many other liberal democratic countries, has had three overriding characteristics: a preference for regulatory standards setting, a tendency to negotiation and exhortation as a substitute for strict legal enforcement of standards, and spending to facilitate industrial adjustment.[3] The first wave of regulatory action on the environment, beginning in the late 1960s, coincided with a period in which increases occurred in many areas of social regulation. Regulation of this type applies horizontally to more than one industry on matters such as employment standards, human rights, and, of course, environmental standards. Social regulation is usually contrasted with direct or economic regulation, which applies in a more

3 See Donald Dewees, *The Regulation of Quality: Products, Services, Workplaces, and the Environment* (Toronto: Butterworths, 1983); D.P. Emad, "Environmental Law and Policy: A Retrospective Examination of the Canadian Experience," in Ivan Bernier and André Lajoie, eds., *Consumer Protection, Environmental Law and Corporate Power* (Toronto: University of Toronto Press, 1985); Peter Nemetz, "Federal Environmental Regulation in Canada," *Natural Resources Journal* 26 (1986): 401–424; Paul R. Portney, ed., *Public Policies for Environmental Protection* (Washington, D.C.: Resources for the Future, 1990), chapter 2; T.F. Schrecker, *Political Economy of Environmental Hazards* (Ottawa: Law Reform Commission of Canada, 1984); Andrew Thompson, *Environmental Regulation in Canada: An Assessment of the Regulatory Process* (Vancouver: University of British Columbia, Westwater Research Centre, 1980); David Vogel, *National Styles of Regulation: Environmental Policy in Great Britain and the United States* (Ithaca, N.Y.: Cornell University Press, 1986); Kernaghan Webb, *Pollution Control in Canada: The Regulatory Approach in the 1980s* (Ottawa: Law Reform Commission of Canada, 1986); and idem, "Between the Rocks and Hard Places: Bureaucrats, the Law and Pollution Control," *Alternatives* 14 (May-June 1987): 4–14.

focused way to one industry on matters of entry, output, and price. Examples here include transport, telecommunications, and energy.[4]

The rise of environmental regulation was spurred by broad public concern about deteriorating environmental conditions. Early environmental interest groups rose up to demand greater government involvement in environmental protection and the government, in turn, played a central role in the survival of such groups.[5] The traditional regulatory approach appeared as the most practical way to achieve needed improvements in environmental quality. Governments throughout the liberal democracies learned from each other and adopted similar approaches to regulation as they addressed problem areas requiring immediate attention. The need for a government response can be tied to market failures of two broad types: spillover — or externalities — and imperfect information.

Spillover results when the price of a product does not reflect important costs of production, such as the cost of air or water pollution to the community at large. Failure to integrate total costs results in artificially high levels of use and misuse of natural assets. Governments must then attempt to act to limit unnecessary damage to the environment.

Imperfect information — first, about the costs of environmental damage and, second, about the health effects of pollutants — results from difficulties regarding private access to information and data analysis. This means that the public cannot adjust for these costs and hazards in their calculations about wages, consumption, location of residence, and life style. Moreover, most people are not able to adjust to these costs and hazards even when they possess information, because they lack the power and resources with which to respond. A government response in the common good is, therefore, necessary.

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4 See G. Bruce Doern, "Social Regulation and Environmental-Economic Reconciliation," in G. Bruce Doern and Bryne B. Purchase, eds., *Canada at Risk? Canadian Public Policy in the 1990s* (Toronto: C.D. Howe Institute, forthcoming).

5 See Donald Chant, "A Decade of Environmental Concern: A Retrospective and Prospective," *Alternatives* 10 (Spring-Summer 1981): 3–7.

In Canada, governments seek to limit pollution through a wide variety of statutes of Parliament and provincial legislatures. Regulatory standards are developed under the legal authority of these statutes and through a process of consultation between government and industry. Other interest groups, such as trade unions, environmental groups, and advisory groups, have become involved in these consultations. This process reflects both uncertainty about the socio-economic impacts of proposed standards and the need to share information about technological solutions and economic effects.

Historically, Canadian regulations have also been developed with a sharp eye for law and practice in the United States, Canada's major trading partner. Traditional regulation is overwhelmingly the dominant approach in the United States, although that country is a decade or so ahead in efforts to apply and determine the effectiveness of market-based measures.[6] In both countries, there has been an emphasis on public health as the driving force for regulations. This has led to a concentration on air and water quality affected by stack emissions and sewage and on toxic substances that pose the most obvious and dramatic threat.

Most environmental regulation is technology based. That is, it is founded on the idea of enforcing and encouraging "best practical technology" or "best feasible technology." In theory, only after all technologically practical or feasible steps are taken will any environmental damage be accepted. In reality, the ability-to-pay criterion is applied, thereby lessening the uniformity of the application of regulatory standards. This has been seen, for example, in the case of pulp and paper effluent regulations, under which old, heavily polluting mills have been excused strict compliance. "Initial compliance monitoring" establishes whether the proper technology is in place. The "monitoring for discharge standard" determines whether the technology continues to work and that emissions remain within limits. Measurements can be taken of absolute pollution densities in waste

6 See Portney, ed., *Public Policies for Environmental Protection*; and Vogel, *National Styles of Regulation: Environmental Policy in Great Britain and the United States*.

water or stack gas or of ratios of pollution to levels of production for a given firm.

Regulatory penalties are assessed when a firm is found to be in breach of a standard. In theory, the penalty is set to capture the firm's savings from not having complied, and thereby eliminate its incentive to devalue the natural stock. Such "penalty assigning" is, however, a very political process and, therefore, less objective and exacting.[7] Environmental regulation also relies heavily on self-monitoring of end-of-pipe discharge, resulting in some concern about accountability. Environmental regulators compensate by conducting industry inspections and "monitoring for ambient quality" in an attempt to assess the benefits of environmental regulation.

Early environmental protection legislation in Canada was written as a blunt prohibition on all polluting emissions. After the 1960s, total prohibitions began to be replaced by legislation that allowed for "control regulatory regimes."[8] Essentially, this was the legal recognition that some pollution was bound to occur from all human production and consumption. The realistic goal was to set standards, and to "control" pollution within the limits or capabilities of the natural environment to cleanse itself. The range of pollution control legislation enacted in the 1970s and 1980s reflected this new thinking on pollution control.

Criminal offenses are associated with environmental protection statutes and regulations, but have rarely been used in Canada.[9] While it may at first appear as straightforward to set standards, monitor results, and prosecute for noncompliance, the process is not that linear or clear cut — in practice, people and production pro-

7 See Canadian Environmental Advisory Council, *Enforcement Practices of Environment Canada* (Ottawa: Supply and Services Canada, 1987); Emad, "Environmental Law and Policy"; and John Swaigen and Gail Bunt, *Sentencing in Environmental Cases* (Ottawa: Law Reform Commission of Canada, 1985).

8 Webb, *Pollution Control in Canada.*

9 See Law Reform Commission of Canada, *Crimes Against the Environment* (Ottawa: Law Reform Commission of Canada, 1985); and Swaigen and Bunt, *Sentencing in Environmental Cases.*

cesses are not "controlled" in this way. Rather, each environmental problem has unique characteristics on a variety of variables that are weighed in the development and enforcement of regulations. The allowance for these variables is built into the specifications of environmental protection legislation, in the sense that government ministers and their representatives have flexibility to determine priorities, thresholds, time horizons, and special exemptions. Some of the variables that must be considered include: the availability of practical technological solutions; the economic viability of the firm or industry; the labor market conditions of the region; and, of course, the political climate. Rather then being typified by clear policing actions, the regulatory process has functioned around "compliance agreements" of various forms between industry and regulators. It is especially in this sense that past approaches cannot accurately be called "command-and-control" in nature.

Regulation of this type, while in many cases unavoidable under existing conditions, has had implications for controlling pollution. Regulatory agreements seek not only to set standards but also to see the firm or industry through the period of adjustment to compliance. Both the regulator and the regulatory process are tied to the circumstances of the industry in ways that are not required by a strict policing function. There is, therefore, considerable flexibility in the development and enforcement of environmental regulations, and often a lack of consistency across enforcement cases. This can happen through no malicious intent of the regulator, but through his or her efforts to account for diverse interests and needs. It has always been the unwritten part of the job description. The problem has generally been exacerbated in Canada, as in many other countries, by the absence of clear enforcement and compliance procedures when these are required in extreme cases.

In Canada, environmental regulators have run into difficulties in the court of law when prosecuting extreme cases.[10] When regula-

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10 See, for example, Emad, "Environmental Law and Policy"; Nemetz, "Federal Environmental Regulation in Canada"; and Webb, "Between the Rocks and Hard Places."

tion is not just policing, but negotiation and agreement making as well, enforcement becomes inconsistent across cases and is challenged on grounds of due process and equality before the law. The entire purpose of the negotiating mode of regulation is to acknowledge and account for the unique circumstances of cases, but the courts are not comfortable with such criteria. The end result of insecurity about legal sanctions is often noncompliance and a blow to the legitimacy of the regulatory process as a whole.

Recent environmental protection legislation, such as the *Canadian Environmental Protection Act*, has attempted to account for these historic problems by more properly balancing the needed policing and negotiating functions. The goal has been to set out clearer procedures for enforcement and compliance to meet fairness and equality requirements, and to integrate citizen participation in the development and enforcement of regulations to restore legitimacy. These changes are outlined later in the chapter.

Exhortation and spending have always been key features of the environmental regulatory process. To exhort or to seek voluntary cooperation from industry has always been the preferred course of action, and is the optimum situation. It is also not particularly surprising that adjustment to standards calls for spending.

In Canada, government spending on environmental protection has generally been of four varieties: grants — in the form of modernization agreements — tax subsidies, loans, and technology transfers. These types of expenditures need not occur separately, and historically they have often been combined and applied in a variety of ways. For example, the federal-provincial Pulp and Paper Modernization Program, established in 1979, combined granting with technology research and transfer. Tax subsidies came mainly as preferred capital cost deductions, such as in the case of the Accelerated Capital Cost Allowance program for environmental protection equipment under the federal tax system. Technology transfers have come under special programs such as the early Cooperative Pollution Abatement Research Program, which was established by DOE in 1970. Loans are often used on major capital or infrastructure investment projects,

such as those offered under the Sewage Containment and Treatment Program established by DOE and Canada Mortgage and Housing Corporation in 1973. Other grant spending comes in the form of funding for groups and for information and product-marketing conferences, such as the Globe 90 Conference recently held in Vancouver. Governments also spend on clean-up programs, such as with the St. Lawrence River Action Plan announced in 1988.

The willingness of Canadian environmental regulators to exhort, negotiate, and spend, as well as to set standards, reflects the complexities and specificities of the problems they face. It also indicates that "command-and-control" is not a wholly accurate label for the traditional regulatory approach. To understand this further, it is useful now to turn to a brief account of the federal Department of the Environment.

The Rise and Fall of DOE

The Department of the Environment had its origins in the October 8, 1970, Throne Speech that opened the third session of the 28th Parliament. Governor General Roland Michener announced that the government would establish a "department to be concerned with the environment and the husbanding of those renewable resources that are part of and dependent upon it, with a mandate to protect the biosphere."

Prior to this, the federal government had been active in establishing environmental protection initiatives in other departments (see Appendix 1). The result of such incremental responses, however, was an uncoordinated array of pollution control initiatives scattered throughout the government. By 1970, there was a flurry of organizational change attempting to bring about better forewarning of environmental problems and a more integrated and coherent approach to the development and implementation of federal policy dealing with the environment. The U.S. Environmental Protection Agency was also established in that year, giving further support to the idea of a new Canadian environment department. DOE received

its mandate from the *Government Organization Act of 1970*, and was officially launched in June 1971, with the following components:

- Atmospheric Environment Service;
- Environmental Protection Service;
- Fisheries Service;
- Land and Forest Wildlife Service;
- Water Management Service;
- Policy, Planning and Research Service; and
- Finance and Administration Service.

Federal statutory initiatives also burst forward in the early 1970s. Box 1 provides a list of the statutes relevant to DOE. In 1970, the *Motor Vehicle Safety Act* was proclaimed, allowing for emissions controls on new motor vehicles. Also in that year, significant changes were made to the *Fisheries Act* permitting new water pollution prevention initiatives. Other federal legislation that year included: the *Canada Water Act*; the *Northern Inland Waters Act*; the *Arctic Waters Pollution Prevention Act*; the *Navigable Waters Protection Act*; the *International Rivers Improvements Act*; and the *Canadian Shipping Act*. In 1971, the *Clean Air Act* received Royal Assent, and in December 1973 the cabinet approved the Environmental Assessment and Review Process.

By 1975, however, when the *Environmental Contaminants Act* was passed, political and socio-economic conditions in and outside Canada had changed to the detriment of continuing improvement on the environmental protection front, and DOE was being relegated closer to the bottom of the government's priority list. Since its formation in 1970, the department had overseen major improvements in environmental policy, but its history from the mid-1970s until recently was typified by four characteristics that limited further progress:

- its inability to establish and carry out rigorous compliance procedures;
- an overtaxed and declining scientific and investigative capacity;

- uncertainty and insecurity in federal-provincial and interdepartmental relations; and
- a lack of economic and legal literacy.

Box 1

Environment Canada's Legislative Mandate

Migratory Birds Convention Act
Canada Water Act
Fisheries Act (sections 36 to 42)
Department of Transport Act (Canals)
International River Improvement Act
Canada Wildlife Act
Canadian Environmental Protection Act (CEPA)
Canadian Environmental Week Act
Game Export Act
Heritage Railway Stations Protection Act
Historic Sites and Monuments Act
Mingan Archipelago National Park Act
National Battlefields at Quebec Act
National Parks Act
National Wildlife Week Act
Weather Modification Information Act

Advisory Role:

Motor Vehicle Safety Act
Arctic Waters Pollution Prevention Act
Navigable Waters Protection Act
Northern Inland Waters Act
Pest Control Products Act
Transportation of Dangerous Goods Act
Canada Shipping Act

Acts Superseded by CEPA:

Clean Air Act
Environmental Contaminants Act
Ocean Dumping Control Act

DOE's ongoing efforts to develop a broader public constituency were not able to overcome this decline.[11] A lack of political will to increase DOE's capacity led to a situation where many pollution-

11 See Michael Whittington, "Department of the Environment," in G. Bruce Doern, ed., *Spending Tax Dollars: Federal Expenditures 1980–1981* (Ottawa: School of Public Administration, Carleton University, 1980), pp. 99–118.

control statutes were not being enforced. Up to 1988, for example, there were only about ten prosecutions under the *Canada Water Act*, the *Environmental Contaminants Act*, the *Clean Air Act*, and the *Ocean Dumping Control Act* combined![12]

In the mid-1970s, there was also a trend toward allowing DOE's enforcement and investigative capacities to whither by transferring much of the responsibility for regulatory enforcement to the provinces. In 1976, for example, the staff of the Science Advisor was cut by over 50 percent from 32 to 14. Other key staff, required for major commitments in contaminants control, were also cut. During the lean years, DOE employees attempted to define an environmental agenda and to make gains where they could on important, high-profile issues such as acid rain and polychlorinated biphenyls (PCBs). The problem was that DOE was also charged by statute with emissions control in areas that were not gaining broad public awareness. For that, DOE lacked much of the required capacity.

The transfer of enforcement responsibilities to the provinces took place at a time when the environment was not as politically attractive an issue as it is today. However, uncertainty about federal-provincial jurisdiction and increasing fiscal pressures made the transfer appear logical. The *Constitution Act of 1867* had not assigned to one level of government the sole responsibility for environmental protection, so that government constitutional powers to act on the environment needed to be derived indirectly from other powers. Areas of overlap in environmental management between levels of government, as well as the opportunities for intergovernmental

12 This is an estimate provided by a DOE enforcement official — it is difficult to get reliable data on formal legal undertakings and prosecutions. While the number of prosecutions is by no means the only — or even the most important — measure of success in environmental protection, it is instructive, particularly considering the significant shortfalls in meeting many environmental protection goals, shortfalls that DOE officials are quick to acknowledge (see Canadian Environmental Advisory Council, *Enforcement Practices of Environment Canada*). Enforcement under the *Fisheries Act* has also been rather less than one would expect, although there has been some action in the Pacific region (see Webb, *Pollution Control in Canada*).

conflict were, and remain, extensive.[13] The concept of "one window of delivery" was devised to answer problems of jurisdictional turf battles. And "environmental accords" were developed to achieve "minimum national standards." But these base standards often remained illusive to the detriment of the legitimacy of the regulatory process. Where provincial practices appeared lax, the federal government was unable to act effectively because it had undercut its own capacity to respond.

Throughout much of its existence, DOE has also been very constrained in its ability to fund industrial adjustment to environmental regulations. Tight budgets — relative to the magnitude of the problems — have limited not only science and enforcement capacities, but also innovative and cooperative industrial adjustment undertakings. The combined result has been a malleable regulatory process based heavily on exhorting compliance agreements. When spending could be called for on employment and regional equity grounds, neither the capacity nor the desire for regulators to act was there. In short, regulators often found themselves without the carrot or the stick.

Confidential consultations between industry and regulators produced problems regarding the consistency of "due process" and public legitimacy. Problems of the latter were exacerbated when compliance agreements appeared insufficient to solve many of the major industrial adjustment problems. The proper balance among exhortation, spending, and legal enforcement was a goal that eluded DOE regulators.

A further constraint on DOE, which has particularly important implications for the present period, is its weak economic and legal literacy. DOE's lack of economic literacy has often resulted in insecurity about the socio-economic impacts of proposed regulations and about its ability to bargain with industry and other economic or industry departments within the federal government itself. The

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13 See Dale Gibbons, "Constitutional Jurisdiction on Environmental Management in Canada," *University of Toronto Law Journal* 23 (1973): 54–87.

department's lack of legal literacy has resulted in its being insecure about developing regulations and prosecuting violators; it has also led to insecurity in DOE's relations with the Department of Justice.

Box 2

Components of the Canadian Environmental Protection Act

Part I:

Environmental Quality Objectives, Guidelines and Codes of Practice. (Regulations cannot be made under this part.)

Part II:

Toxic Substance Provisions providing for:

- information gathering;
- controls on substances new to Canada;
- broad regulatory authority;
- interim orders for emergencies;
- clean-up of unauthorized releases;
- ministerial authority to direct remedial measures;
- export and import controls;
- control of lead in gasoline.

Part III:

- Nutrient Control in cleaning agents (previously Part III of the *Canada Water Act*).

The end result has been that few regulations have actually been put on the books.

Throughout much of its history, in fact, DOE has not only had difficulty "controlling", but has even lacked much of the capacity to set "commands". The magnitude of the task has been beyond the scope of the resources and capacities made available to DOE officials. Recent changes have attempted to overcome this weakness and to address the four key problem areas examined above.

The *Canadian Environmental Protection Act*

Developed as a response to broad public concern about toxic substances, the *Canadian Environmental Protection Act* (CEPA) has

become the federal government's flagship environmental protection statute. The legislation was tabled for first reading on July 26, 1987 (see Box 2). The final version, made stronger as a result of public

Box 2 - *continued*

Part IV:

Federal Subjects regulatory authority to control (pursuant to the provisions under the act):

- federal departments, boards, and Crown corporations;
- federal lands;
- federal works or undertakings with federal legislative authority.

Part V:

International Air Pollution (previously part of the *Clean Air Act*).

Part VI:

Ocean Dumping Control (previously the *Ocean Dumping Control Act*).

Part VII:

General Provisions for:

- boards of review;
- agreements with the provinces;
- powers of inspectors;
- penalties and legal issues.

Part VIII:

Consequential Amendments and Repeal of Predecessor Legislation.

Part IX:

Act Proclaimed in Force.

consultations on the earlier draft, went into effect on June 29, 1988.[14]

14 See Gisèle Jacob, Roy Bégin, and John MacLatchy, "Application of Federal Environmental Enforcement and Compliance Policies" (Paper prepared by Department of the Environment, Regulatory Affairs, Conservation and Protection, for presentation to the Canadian Bar Association, Hull, Quebec, January 19, 1990).

Enforcement and Compliance

One of CEPA's key goals is to set out enforcement and compliance procedures that will not only address many of the problems of due process and equality before the law, but also decrease uncertainty between regulator and regulated by more clearly setting out the rules of the game. An attempt has been made to ground these procedures — documented in a companion Enforcement and Compliance Policy — firmly in the law. The policy provides guidance to inspectors regarding their powers under the act and attempts to address public concerns about the legitimacy and effectiveness of the regulatory process.

Under CEPA, inspectors have the right to conduct "inspections" and to review materials, substances, records, books, electronic data, or other documents that are subject to the act or relevant to its administration. If a violation is discovered, the inspector can choose one of a number of courses of action depending on the severity of the case. A "letter of warning" or "compliance direction" is issued for a minor violation and when it is expected that the recipient will be willing to correct the situation promptly. A follow-up is made to ensure that the work is done. If the offence is more severe, the inspector can request a "ministerial order", a "court injunction", and/or proceed to "prosecution". A formal investigation, including search and seizure of pertinent evidence and information, can proceed when the case is deemed to be severe. In such cases, the inspector can act to correct the environmental hazard and then pursue compensation for the Crown through the courts with the aid of the Department of Justice. Letters of warning, compliance directions, inspections, investigations, and other enforcement actions remain on the "compliance record" of the regulated firm. The consistent application of these procedures is intended to meet the requirements of the courts and to encourage industry to maintain a good record.

It remains true, however, that DOE regulators prefer to work *with* industry — rather than to go through these formal procedures — to ensure compliance with the regulations. This has generally

Table 1

Enforcement Actions under the Canadian Environmental Protection Act, June 1988–March 1990

Regulations	Inspections/ Investigations	Enforcement Actions
PCB[a] Waste Storage	1,347	128
PCB Interim Order	1,017	104
Gasoline, Unleaded	1,652	11
Gasoline, Leaded	395	5
Contaminated Fuels	733	38
Secondary Lead Smelters	35	1
Chlor-Alkali (Mercury)	46	0
Vinyl Chloride Plants	6	0
Asbestos Mines	32	4
Phosphates	184	10
Ocean Dumping	254	35
CFCs[b]	84	0
PCB Mobile Destruction	36	1
Total	*5,821*	*329*

[a] Polychlorinated biphenyls.

[b] Chlorofluorocarbons.

Source: Gisèle Jacob, Roy Bégin, and John MacLatchy, "Application of Federal Environmental Enforcement and Compliance Policies" (Paper prepared by Department of the Environment, Regulatory Affairs, Conservation and Protection, for presentation to the Canadian Bar Association, Hull, Quebec, January 19, 1990).

resulted in few prosecutions, although the use of formal legal procedures and enforcement actions has increased (see Table 1). Disaggregated data covering the eight months between April and November of 1989 show that there were 2,858 inspections, 129 investigations, 207 warnings, 5 directions, 2 cases submitted to the Department of Justice for review, 3 prosecutions, and 2 convictions. The lack of disaggregated data for the entire period covered by the table indicates, however, that the government still has a long way to go in making data available to the public.

CEPA has two other enforcement and compliance features that address the public legitimacy of the environmental regulatory process. Sections of the act require that regulations be written, and a Priority Substances List contains 44 substances that must be tested for their toxicity within five years. The public can request investigations under the act and also that additional substances be added to the list of priority substances. An investigation must be conducted if two people over the age of 18 petition the minister to look into an alleged violation of the act or the environmental implications of a substance. Twenty regulations or interim orders are currently in place under CEPA, and DOE states that there will be another 30 by 1995 (Appendix 2 provides a list of the regulations now in place; Appendix 3 provides a priority list for the 1990 regulatory agenda). The regulatory process for the development of regulations is also intended to become a more formal and broadly consultative process under the act.

CEPA is barely more than two years old, and it is too early to tell whether these new enforcement and compliance provisions can help solve the problems noted earlier in this chapter. It does, however, appear to be a step in the right direction within the traditional regulatory approach. An effort has been made to balance the carrot and the stick and to make the process fairer, more consistent, and more predictable.

Federal-Provincial Relations

According to one senior DOE official, CEPA was primarily about "sorting out federal-provincial relations." This may be an exaggeration, but federal-provincial conflict over environmental protection has been extensive. A "one-window-of-delivery" approach has often led to the federal government's being shut out of enforcement and compliance. Provincial reporting of compliance success or failure to the federal government has been very uneven.

One way in which the federal government, through CEPA, has attempted to instill more stable and rigorous intergovernmental

environmental relations is by allowing regulators to enter into "equivalency agreements", under which a province can be exempted from CEPA's regulations. These agreements must, however, stipulate that every act of noncompliance be followed up by an act of enforcement. The goal is to develop an identifiable and sustainable national standard while also achieving cost efficiencies by avoiding overlap. In the absence of an equivalency agreement, federal regulations apply.

In order for the threat of federal interdiction to be taken seriously, DOE has had to build better enforcement and compliance capacities, and federal regulations can be brought back into effect if a province does not adhere to an equivalency agreement. CEPA still allows regional and case-by-case regulatory flexibility, but the process of negotiation and agreement setting is intended to be more rigorous, balanced, and predictable than before. Interjurisdictional competition may, therefore, benefit environmental protection.

Provincial regulators have generally supported the idea of equivalency agreements, because they permit autonomous action and the taking of political credit once they are reached. The problem, however, is that no such agreements currently exist, and they are difficult to negotiate. While there is now a move toward more formal federal-provincial negotiation, and DOE is likely to be less insecure in putting its views forward — at least in the near future — time will tell whether the needed strengthening of DOE's capacities will continue and whether greater federal-provincial agreement on enforcement and compliance will result in effective and efficient action in environmental policy implementation.

Science and Investigation

Good scientific and investigative capacities are vital to any effort to improve enforcement and compliance procedures and practices. CEPA specifically calls for rigorous feedback reporting to overcome vast shortfalls in this area. According to DOE officials, inroads are beginning to be made toward building these capacities.

Because of regulatory complexity and the resultant need for good planning, however, new types of science and investigation are required. Continued improvement of scientific measurement is vital, but new skills in assessing the financial, technological, and market conditions of industries and firms are also required. The face of enforcement and compliance monitoring in environmental regulation is changing, and likely will continue to do so with the increasing complementary use of market-incentive approaches. Good environmental policy implementation will require new types of information and, thereby, will result in a changed composition for regulatory departments. There is a long way to go on these matters, but some of the recent efforts appear to be in the right direction.

Economic and Legal Literacy

Because of CEPA's requirements regarding the creation of regulations, rigorous reporting, and enforcement and compliance, the need to improve DOE's economic and legal literacy is clear. DOE's relative lack of these strengths has meant that its officials have been at a considerable disadvantage in negotiations with other stakeholders during the development and enforcement of regulations. CEPA's regulatory process puts a great deal of pressure on the economic and legal analysis capacities of DOE. As can be seen in Figure 1 — which depicts the regulatory process by illustrating the various stages of consultation and decisionmaking — a "Regulation and Impact Assessment Study" (RIAS) must be completed for each new regulation being proposed. These studies assess the socio-economic impacts likely to result from the regulation. The process also requires multiple drafts of regulations for stakeholder consultation, which must conform to the law. A substantial commitment of resources is required to meet both of these demands.

Two trends have developed within DOE to attempt to account for this. First, there has been an effort to build up a capacity for economic analysis within the department's Corporate Group. Second, an effort has been made to reach better legal arrangements and

procedures with the Department of Justice, through the Compliance and Federal Registry Project. These are steps in the right direction, but, again, there remains a long way to go. For example, the Regulatory and Economic Affairs Group within the Environmental Protection Directorate, which is charged with socio-economic studies under the CEPA regulatory process, had accumulated only 5 person years of experience as of June, 1990. Moreover, while the Directorate is central to the administration of CEPA, it has negligible legal capacity. Both of these factors promise to contribute to a bottleneck in a regulatory process that is already seen to be quite sluggish. More work needs to be done to develop these capacities where they are directly relevant to the administration of CEPA. Industry and other stakeholders require better information about the likely economic impacts of regulations in order to plan effectively. Good economic analysis is central to measuring the costs and benefits of regulation. Furthermore, research should be conducted on ways to streamline the CEPA regulatory process in general, so that it can answer needs more effectively and efficiently.

Conclusions

The traditional regulatory approach, as reflected in this chapter's look at DOE's strengths and weaknesses, cannot accurately be labeled as being driven by a command-and-control approach. Accordingly, weaknesses in the past practice of traditional regulation will need to be addressed in concert with the application of new market-incentive approaches. The success of these approaches will require a strong formative role for DOE, reliable enforcement and compliance practices, stable and predictable federal-provincial relations, better scientific and investigative capacity, and highly developed economic and legal literacy.

The move to greater consideration of market-incentive approaches is a positive development around which much more research and practice should be encouraged. Emissions charges and tradable permits appear as particularly promising methods for inte-

Figure 1

Stages in the CEPA Regulatory Process

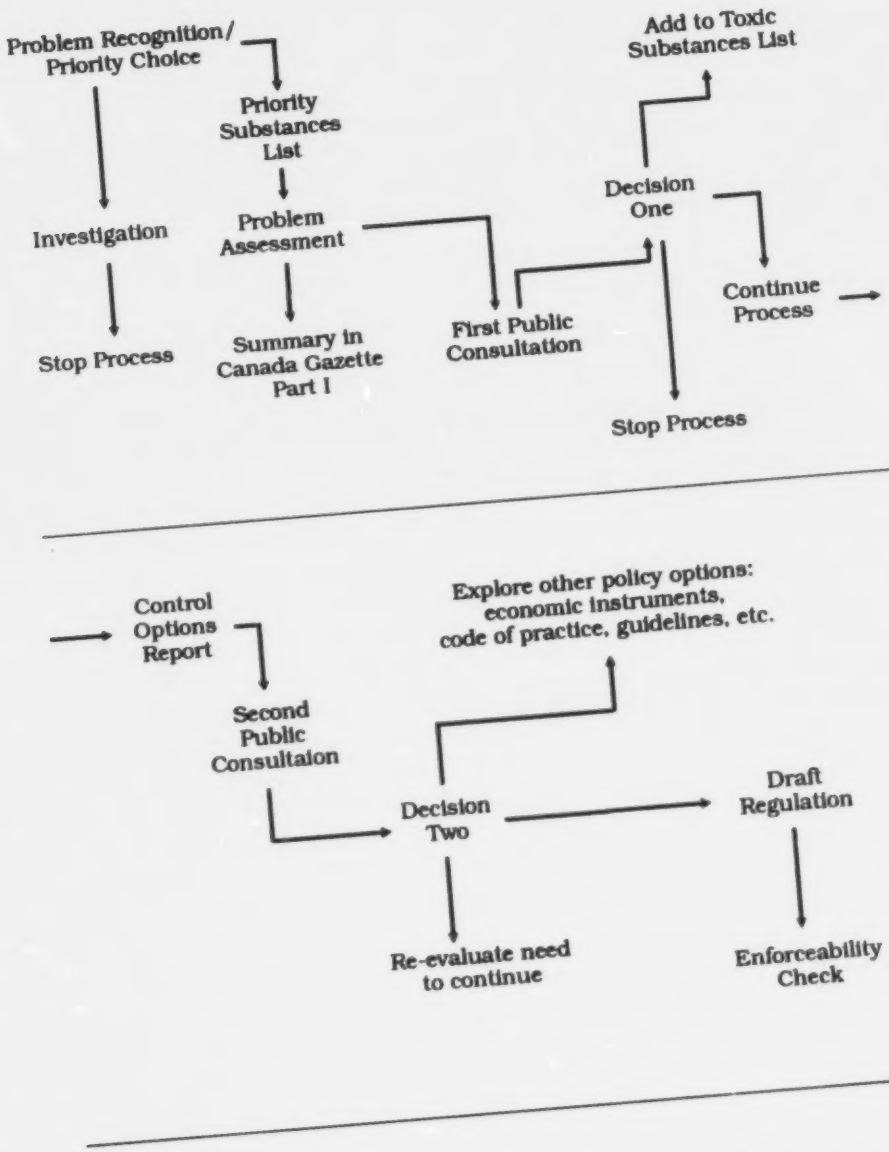
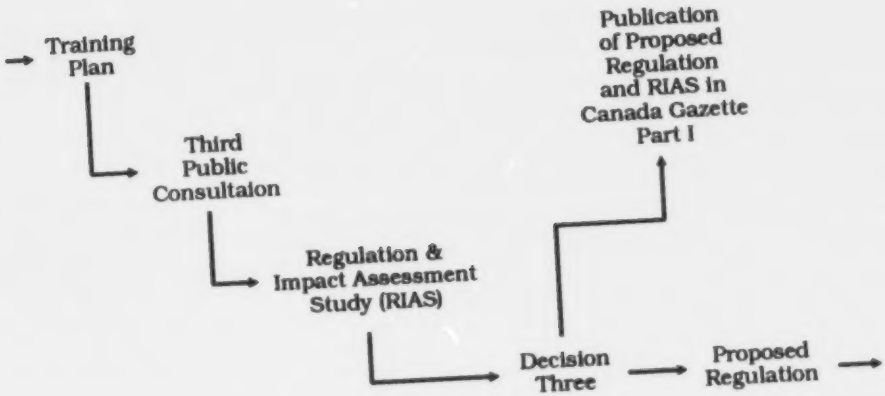
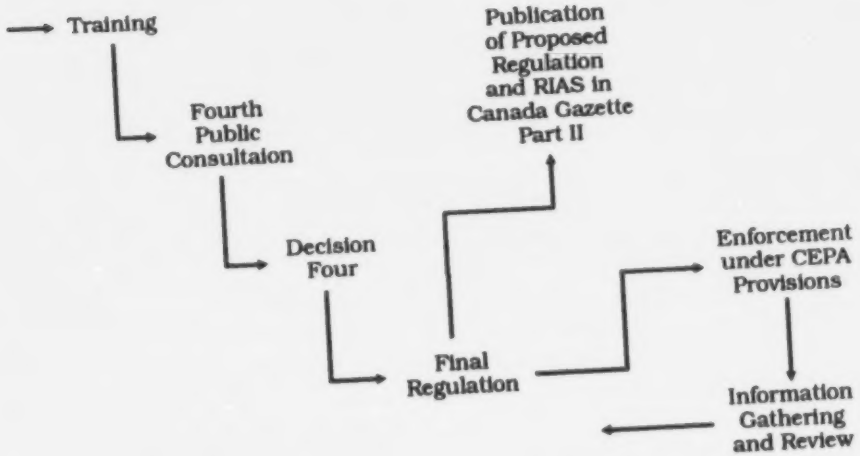


Figure 1 - *continued*


Training Plan
Third Public Consultaion
Regulation & Impact Assessment Study (RIAS)
Decision Three
Publication of Proposed Regulation and RIAS in Canada Gazette Part I
Proposed Regulation



grating the total costs of production into the pricing system. The gains in cost efficiencies to the community at large could be substantial through acceptance of the market as policy instrument. Furthermore, it is very likely that new technological innovations will arise with much greater frequency when industries are given maximum possible latitude in determining how adjustments should be made. Flexibility in adjustment will be critical when one considers that standards will need to become more stringent if necessary environmental quality gains are to be made and market-based approaches are to work well.

There are likely to be many problem areas, however, where market-based approaches will simply not be feasible under existing political, economic, and social conditions. New market-incentive approaches will need to be built on a solid base of traditional regulation. In many cases hybrid approaches, combining elements of the two, will be desirable. These decisions will need to be made on a case-by-case basis, and officials will have to have a well-developed selection of policy instruments at their disposal to meet diverse needs. It is for this reason that the federal government will not only need to get better at putting the market to work; it will also have to become much better at traditional regulatory standards setting than it has been in the past. There is a place for regulation, and it need not be enforced inefficiently nor be devoid of positive efficiency implications for industry.

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Appendix 1

Key Canadian Government Organizational and Legislative Changes in the Area of Environmental Protection since 1871

1871 The Atmospheric Environment Service is started.

1887 The national parks system begins, starting with the legal formation of Banff National Park. The administration of the parks is to be taken over by the Department of the Interior.

1899 The Canadian Forestry Service originates as the Timber Branch within the Department of the Interior.

1909 The International Joint Commission is formed to administer to the Canada-United States Boundary Waters Treaty.

1919 The Historic Sites and Monuments Board first meets.

1930 Forest resources are transferred to the provinces.

1939 The Canadian Forces Weather Service begins.

1947 The Dominion Wildlife Service is established. It later becomes the Canadian Wildlife Service.

1960 The Department of Forestry is established.

1966 Water-related programs are consolidated under the Department of Energy, Mines and Resources (EMR), and organized into the Marine Services Branch, Inland Waters Branch, and Policy and Planning Branch.

The Department of Indian Affairs and Northern Development (DIAND) is established and incorporates a Conservation Program, including National Parks and Historic Parks and Sites.

The Department of Forestry reverts to the Forestry Branch within the Department of Forestry and Rural Development (DFRD).

1967 The Canada Centre for Inland Waters is established.

1969 DFRD is joined with the Fisheries Department to form a new Department of Fisheries and Forestry (DFF).

The Air Pollution Control Division is established within the Department of Health and Welfare.

The *Government Organization Act* allows for the creation of the Department of Fisheries and Forestry, which will come to include an Environmental Quality Directorate (beginning in 1970), the forerunner of the Environmental Protection Service of the Department of the Environment.

1970 The Canadian Forestry Advisory Council is established.

The Speech from the Throne opening the 28th Parliament announces the government's intention to establish "a department concerned with the environment."

The Minister of Fisheries and Forestry receives new responsibilities for: the Canadian Wildlife Service previously at DIAND; water-related programs from EMR; Air Pollution Control Division from Health and Welfare; and the Meteorological Branch from the Department of Transport.

The *Canadian Motor Vehicles Safety Act* is proclaimed, enabling emissions controls to be set.

Amendments to the *Fisheries Act* include provisions for pollution prevention and control.

The *Canada Water Act*, *Arctic Waters Pollution Act*, *International Rivers Improvements Act*, and the *Canada Shipping Act* are also developed.

1971 The Department of the Environment (DOE) is officially formed. Its components are:

- Atmospheric Environment Service;
- Environmental Protection Service;
- Fisheries Service;
- Land, Forest and Wildlife Service;

- Water Management Service;
- Policy Planning and Research Service;
- Finance and Administration Service;
- Forestry Advisory Council;
- Fisheries Advisory Council.

The *Clean Air Act* receives Royal Assent.

1972 The Canada Centre for Inland Waters officially opens.

1973 The *Canadian Wildlife Act* is passed.

Cabinet approves the Environmental Assessment and Review Process.

The Canadian Environmental Advisory Council is established to provide [BRUCE: TEXT BREAKS OFF HERE, FOR ONE OR TWO LINES]

1974 The Federal Environmental Assessment and Review Office (FEARO) is formed.

The Environmental Protection Service of DOE is reorganized around regional administrative principles.

A Minister of State for Fisheries is appointed to aid the Minister of the Environment.

1975 The *Environmental Contaminants Act* receives Royal Assent.

The *Ocean Dumping Control Act* is passed.

An Audit Services Branch is formed within DOE.

1975–76 The Air Pollution Technology Centre is established.

The Oil Spill Technology Centre is established.

The Northern Technology Centre is established in Edmonton to develop and demonstrate the technology of waste-water treatment.

1976 The Minister of Fisheries is assigned responsibility for both Fisheries and the Environment. The department is renamed the Department of Fisheries and the Environment. The Minister is known as the Fisheries Minister.

1977 A Minister of State for the Environment is appointed to assume responsibility for the Environment component of the department.

A National Forest Pest Management Institute is established in Sault Ste. Marie.

1979 The *Government Organization Act of 1979* creates a new Department of Fisheries and Oceans (DFO) that is separate from the old Department of Fisheries and the Environment. The creation of DFO re-establishes a distinct Department of the Environment.

DOE is reorganized to give the Forestry Service a higher profile and to establish Departmental Regional Directors General.

The Petawawa National Forestry Institute is formed.

Parks Canada is transferred to DOE from DIAND.

1982 Responsibility for joint federal-provincial forestry agreements is transferred from the Department of Regional Economic Expansion to DOE.

1984 The Canadian Forestry Service is transferred to the Department of Agriculture.

The Environmental Assessment and Review Guidelines are modified through an Order-in-Council.

1986 DOE's separate Conservation and Protection Services are consolidated into one. Responsibilities of Regional Directors General are transferred to the new service.

The Priority Issues Directorate is transferred to the Corporate Planning Group of the Administrative Program.

1988 The *Canadian Environmental Protection Act* is proclaimed.

Amendments are made to the *National Parks Act.*

1990 The government's Green Paper, *An Environmental Agenda for Canada,* is released.

The *Canadian Environmental Assessment Act* is tabled, partly in response to court cases.

Appendix 2

Regulations Published under the Canadian Environmental Protection Act

Replacing Previous Regulations under the Clean Air Act

1. Secondary Lead Smelter Release Interim Order.
2. Vinyl Chloride Release Regulations.
3. Chlor-Alkali Mercury Release Regulations.
4. Asbestos Mines and Mills Release Interim Order.
5. Gasoline Regulations (replacing 2 previous regulations).
6. Fuels Information Regulations, No. 1.

Replacing Previous Regulations under the Environmental Contaminants Act

1. Chlorobiphenyl Interim Order (replacing 3 previous regulations).
2. Polybrominated Biphenyl Regulations.
3. Chlorofluorocarbon Regulations.
4. Polychlorinated Terphenyl Regulations.
5. Mirex Regulations.

Replacing Previous Regulations under the Canada Water Act

1. Phosphorous Concentration Regulations.

Replacing Previous Regulations under the Ocean Dumping Control Act

1. Ocean Dumping Regulations.

New Regulatory Initiatives

Interim Orders:

1. PCB Wastes Interim Order.
2. Contaminated Fuel Interim Order.

Regulations:

1. Ozone-Depleting Substances Regulations No. 1.
2. Ozone-Depleting Substances Regulations No. 2.
3. Ozone-Depleting Substances Regulations No. 3.
4. Federal Mobile PCB Treatment and Destruction Regulations.

Note: Interim Orders remain in effect for two years, at which time they must be replaced by regulations or they lapse. Proposed regulations appear in *Canada Gazette*, Part I, allowing 60 days for public comment. After that period, they may be passed into law and are published in *Canada Gazette*, Part II, assuming there is no board of review resulting from public comment.

Source: The information in this Appendix is derived from sources within the Environmental Protection Directorate of the Department of the Environment; much of it can also be found within the Federal Regulatory Plan 1990 for Environment Canada, produced by the Office of Privatization and Regulatory Affairs.

Appendix 3

The Federal Government's Proposed 1990 Regulatory Agenda for the Environment

Canadian Environmental Protection Act

1. Export of PCB waste.
2. New substances notification.
3. Export of toxic substances.
4. Hazardous waste management at federal facilities.
5. Chlorinated dioxins and furans.
6. Chlorinated organic substances.
7. Confidential names of substances.
8. Request for confidentiality.
9. Rules for Boards of Review.
10. New substances notification (biotechnology).
11. Spills reporting.
12. Non-hazardous solid-waste incinerators at federal facilities.
13. Export and import of hazardous waste.
14. Disposition of fines and penalties.
15. Amendments to existing regulations concerning: secondary lead smelters; vinyl chloride; chlor-alkali mercury; and PCB (products).

Fisheries Act

1. Pulp and paper effluent regulations.
2. Pulp and paper authorizations regulation.

Source: The information in this Appendix is derived from sources within the Environmental Protection Directorate of the Department of the Environment; much of it can also be found within the Federal Regulatory Plan 1990 for Environment Canada, produced by the Office of Privatization and Regulatory Affairs.

3 Environmental Regulation: *Performance and Design Standards*

Benoit Laplante

Despite economists' preference for the use of market-oriented policies such as emissions and effluent taxation or marketable permits, regulators throughout the world have typically preferred to use a more direct approach to achieve environmental quality objectives.

In practice, the regulator first sets specific maximum levels of emissions for polluters engaging in a common activity.[1] The regulator then selects the type of regulation to impose on polluters in order to achieve the desired levels of emissions. The regulator may choose to leave the firm with absolute freedom to adopt whatever means it wants to achieve the targets. This policy is referred to as a "performance standard". On the other hand, the regulator may specify precisely the type of emissions-control technologies the firm has to adopt to comply with emissions limits. This policy is referred to as a "design standard". Whether the regulator uses a performance or a design standard, it finally has to monitor the firm's degree of compliance against the stated objectives.

This overall type of regulatory intervention is commonly referred to as the "command-and-control" approach — meaning the command of behavior, the control of compliance, and the imposition of

1 For ease of exposition, polluters are assumed to be firms. This, of course, need not be the case.

fines, if necessary. Given that market-oriented policies allow emissions limits to be achieved at the lowest social cost, one must explain why the vast majority of regulators have preferred to use the command-and-control approach.[2]

The tendency to appeal to direct intervention rather than to market forces is not restricted to environmental protection but is common to every field of governmental intervention. Environmental groups, however, typically have been advocates of policies of direct control over polluters. For these groups and, one could fairly say, for the public in general, effluent taxes or marketable permits — sometimes misleadingly referred to as "pollution rights" — are seen as a license to pollute and, as such, should be rejected.[3] Finally, since it is less expensive for existing polluters to comply with emissions limits under the command-and-control approach — other things being equal — they have also expressed a strong preference for that approach over emissions taxes or marketable permits.[4] Regulators, polluters, and the public, therefore, have all expressed a preference for the use of direct interventions.[5]

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2 For a more extensive discussion of this approach, see the chapter by Tom Conway in this study. See also P. Bohm and C.S. Russell, "Comparative Analysis of Alternative Policy Instruments," in A.V. Kneese and J.L. Sweeney, eds., *Handbook of Natural Resource and Energy Economics*, vol. 1 (New York: Elsevier Science Publishers, 1985); and J. Pezzey, "Market Mechanisms of Pollution Control: 'Polluter Pays', Economic and Practical Aspects," in R.K. Turner, ed., *Sustainable Environmental Management, Principles and Practice* (London: Belhaven Press, 1988).

3 This argument fails to recognize that, under the command-and-control approach, polluters have the absolute right to (freely) pollute up to the specified maximum levels of emissions. Under market-oriented policies, each and every unit of emissions has to be paid for.

4 For a more detailed explanation of polluters' preference for the command-and-control approach, see J. Buchanan and G. Tullock, "Polluters' Profits and Political Response: Direct Controls vs Taxes," *American Economic Review* 65 (1975): 139–147.

5 Market-oriented policies are rarely used. Where regulators have used emissions or effluent taxation, the purpose has been to raise revenues rather than to give polluters the incentive to reduce their levels of emissions. Where marketable permits have been used, observers have identified a number of rigidities that have prevented the system from achieving its objectives in a significant way...

Stating that different parties support or benefit from the adoption of the command-and-control approach does not, however, explain how a regulator chooses between a performance standard and a design standard. The purpose of this chapter is to examine the command-and-control approach and to indicate the relative strengths and weaknesses of performance and design standards.[6]

The chapter as a whole defends two propositions. The first is that the lack of information needed for setting "acceptable" emissions limits also prevents an adequate enforcement of environmental policies. Or at least, if the lack of information does not prevent the regulator from setting targets, it does allow polluters to manipulate the monitoring process to their advantage, thus compromising the entire program of emissions control. This has led many observers to qualify the regulatory process as arbitrary, even symbolic.

The second proposition is that the *social* cost of an emissions-abatement program may be lower under a design standard, despite the fact that the polluter's cost is lower under a performance standard. Since a firm has every incentive to comply with targets at the lowest cost, it is often argued that regulators should use a performance standard, thus giving the firm absolute flexibility to

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...For more on this, see R.W. Hahn, "Economic Prescriptions for Environmental Problems: How the Patient Followed the Doctor's Orders," *Journal of Economic Perspectives* 3 (1989): 95–114; idem, *A Primer on Environmental Policy Design* (New York: Harwood Academic Publishers, 1989); and Organisation for Economic Co-operation and Development, *Economic Instruments for Environmental Protection* (Paris, 1989).

6 The literature analyzing the different aspects of the existing and evolving sets of environmental policies is extensive. See, for example, A.C. Fisher, *Resource and Environmental Economics* (Cambridge: Cambridge University Press, 1981); F.R. Forsund and S. Strom, *Environmental Economics and Management: Pollution and Natural Resources* (London: Croom Helm, 1988); D.W. Pearce and R.K. Turner, *Economics of Natural Resources and the Environment* (New York: Harvester Wheatsheaf, 1990); and P.R. Portney, *Public Policies for Environmental Protection* (Washington, D.C.: Resources for the Future, 1990). A standard reference is W.J. Baumol and W.E. Oates, *The Theory of Environmental Policy*, 2nd ed. (Cambridge: Cambridge University Press, 1988).

adopt the emissions-control policies that best fit its own unique characteristics. Indeed, there is no doubt that the polluter's cost — that is, the *private* cost — of meeting targets is lower under a performance standard than under a design standard.[7] This chapter argues, however, that a performance standard may not minimize the social cost of accomplishing that same objective.[8] This is particularly the case if the polluters are a small number of firms in an oligopolistic industry.

The regulatory process proceeds in essentially three steps: the setting of emissions limits, the definition of policies through which these limits can be achieved, and, finally, the enforcement of regulations. Accordingly, the chapter first presents the way in which emissions limits should be specified. Then, after discussing the immense information problems facing the regulator, the chapter describes the way in which emissions limits are actually specified. This leads us to the notions of "best available" and "best practicable" technologies. Following that is a discussion of the use of performance and design standards, in which the regulator's argument for the use of performance standards is presented. An example is then given showing that, despite the alleged superiority of performance standards, in some circumstances social welfare is higher under design standards. The chapter concludes by examining enforcement problems, showing that the lack of information prevents an adequate enforcement of environmental regulations.

Setting Emissions Limits

In Canada, both the federal and provincial governments can adopt laws and regulations aimed at controlling environmental degradation. Typically, the laws express the goals and purposes of the

7 This is the justification given by the Ontario Ministry of the Environment for relying on performance standards in its Municipal/Industrial Strategy Abatement program.

8 The social cost is the cost that the emissions-control program imposes on the entire society. The private cost is the cost that the program imposes solely on polluters.

intervention, and define the rules and conditions under which a government can regulate specific firms or industries. Environmental laws may also specify very broad interdictions against pollution. The *Canadian Fisheries Act*, for example, provides that:

> Subject to subsection (4), no person shall deposit or permit the deposit of a deleterious substance of any type in water frequented by fish or in any place under any conditions where the deleterious substance or any other deleterious substance that results from the deposit of the deleterious substance may enter any such water.[9]

This is a very broad prohibition indeed. If it were strictly enforced, every firm emitting any sort of deleterious substance in water frequented by fish would be required to reduce its emissions to zero — at any cost — or cease operation. This may not have been the intention of the legislators. Subsection (4) of Article 36 reads:

> No person contravenes subsection (3) by depositing or permitting the deposit in any water or place of waste or pollutant of a type, in a quantity and under conditions authorized by regulations applicable to that water or place made by the Governor in Council under any Act other than this Act,[10]

meaning that the Governor in Council may adopt regulations according to which maximum levels of emissions are defined and up to which firms can pollute without contravening the act.[11]

With respect to these emissions limits, one should note the following three major characteristics. First, regulations are specific only to a given industry — firms in two different industries may emit

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9 *Canadian Fisheries Act*, R.S.C. F-14, 36 (3).

10 Ibid.

11 Pursuant to the act, regulations and guidelines now exist for six manufacturing and processing industry establishments: chlor-alkali, meat and poultry, metal mining, petroleum refining, potato processing and pulp and paper. Additional regulations have also been adopted pursuant to the *Canadian Environmental Protection Act*.

the same pollutant, but a particular piece of regulation may apply only to firms in one industry, not to those in the other — and are thus defined at the industry level.

Second, within a regulated industry, new sources of pollutants typically face more stringent emissions limits than do old sources. For example, the Pulp and Paper Effluent Regulations provide that new mills (defined as those that have commenced operation since November 2, 1971) expanded mills (those that, since November 2, 1971, have installed equipment that has increased their production by 10 percent or more), and altered mills must achieve greater emissions control than existing mills. Similarly, the Petroleum Refinery Liquid Effluent Regulations apply only to refineries that began to process crude oil on or after November 1, 1973, and the Metal Mining Liquid Effluent Regulations apply only to metal mines that began operation after February 25, 1977.[12]

Finally, the specified limits for old sources apply uniformly to every old source of the regulated industry (the same is true for new sources). Our concern here is the method by which the emissions limits are defined. Theoretically, it is simple to set optimal levels of emissions, but because of information problems, federal and provincial regulators have resorted to a technique commonly referred to as the "best available" or "best practicable" technology. The next section discusses the way in which optimal levels of pollution are defined and the information problems associated with this process. This is followed by a discussion of how the present set of regulations defines the limits to be imposed on firms.

The Theoretical Framework

The first step of the environmental regulatory process is to determine the maximum allowable level of emissions of a pollutant that a firm

12 Firms that are in an industry that is regulated, but for which regulations do not apply, are sometimes subject to guidelines. This is the case for existing metal mines — mines that were in operation before February 25, 1977. These guidelines essentially replicate the regulations, with the important difference that failure to meet the guidelines is not in itself an offence.

produces. In setting this limit, the following procedure is used. Suppose that firm i produces a given pollutant, X. In Figure 1, $\overline{X}$ is firm i's unregulated level of emissions of X. The curve labeled D_i represents the environmental damage (in dollars) caused by each unit of pollutant X produced by firm i.[13] It increases with the level of pollution, since, the higher the emissions level, the more damage an extra unit of pollutant X creates. The other curve, labeled C_i, represents firm i's cost to reduce a further unit of pollutant X. It is drawn under the normal assumption that the more the firm reduces its emissions of the pollutant, the more expensive it becomes to reduce these emissions still further.[14] Firm i's optimal level of emissions, X^*, is determined by the intersection of the two curves. The damage caused by any unit of pollution above X^* is higher than the social cost of removing it — therefore, this pollution should be eliminated. The social cost of eliminating any unit of pollution below X^* is higher than the damage it causes — therefore, this pollution should not be abated. At X^*, the extra abatement cost equals the extra damage.

The level of damages caused by a unit of emissions obviously depends on the type of pollutant. It also depends on other factors such as the relative proximity of inhabited areas, the direction and velocity of wind (for atmospheric emissions), the flow and temperature of water (for effluent emissions), and other factors relating to the location of the firm. For example, a unit of carbon dioxide does not cause the same physical damages as a unit of chlorofluorocarbon. Similarly, a unit of carbon dioxide emitted in downtown Toronto does not cause the same amount of damage as a unit emitted in the relatively cleaner atmosphere of Whitehorse. Hence, the curve

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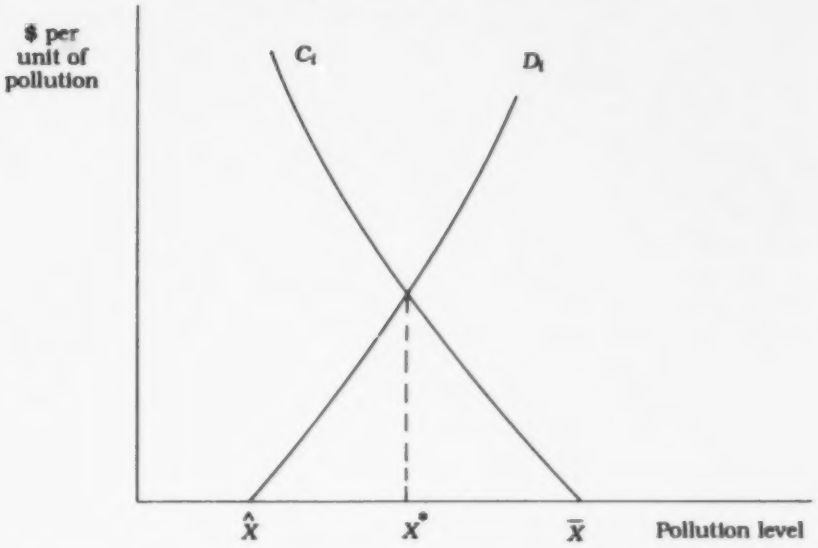
13 This line has been drawn under the assumption that the environment possesses a natural capacity to absorb a certain amount of emissions without damage. This is why D_i is positive only for emissions levels greater than X. For many toxic pollutants, however, the environment may not exhibit such an assimilative capacity. In such cases, D_i is positive from the very first unit.

14 A study by the U.S. Environmental Protection Agency found that it would cost above US$60 billion to reduce effluent emissions by 85 to 90 percent, and an *additional* US$200 billion to eliminate the remaining 10 to 15 percent.

Figure 1

The Optimum Level of Pollution



D_i is specific to a firm's location and to the type of pollutant. Different firms also have access to different ways of controlling their levels of emissions. Some firms will find it less expensive to reduce their levels of production, others to change their input mix, still others to install emissions-control technologies. Hence, emissions-control costs are also specific to the firm.[15] Consequently, the optimal level of pollution (as determined in Figure 1) is likely to vary from firm to firm, even within the same industry. The aim of environmental regulation, therefore, should be to estimate these functions for each firm, and to set the maximum allowable levels of emissions at their optimal levels.

15 One study reports that it would cost 5 cents to remove an additional pound of biological oxygen demand from a beet sugar refinery, but 22 cents to remove it from a petroleum refinery. See A. Kneese and C. Schultze, *Pollution, Prices and Public Policy* (Washington, D.C.: Brookings Institution, 1975).

Information Problems

The process of estimating the environmental damage caused by a particular pollutant (curve D_t in Figure 1) requires a formidable amount of information. Unfortunately, that information is not available for the vast majority of the 50,000 or so chemicals in commercial use today. Moreover, combinations of various pollutants can exacerbate or even cancel out the capacity of any particular pollutant to cause damage.

For all practical purposes, then, the specific relationship between pollutants and the environmental damage they cause remains unknown. While this information is necessary to determine X^* in Figure 1, it is not sufficient. Once physical damage has been identified, the next step is to determine the value society attributes to this damage. In other words, how much and what resources is society willing to set aside in order to prevent further deterioration of the environment?[16] How much is it willing to pay to protect the Amazon or to stop the emissions of pollutants that threaten beluga whales in the St. Lawrence River? What resources is society willing to devote to reduce the level of ozone — mainly caused by automobiles — in downtown Vancouver, Toronto, and Montreal? Yet, in spite of the difficulty of obtaining such information, it is critical for an accurate estimate of curve D_t.[17]

Estimating the costs of pollution abatement — curve C_t in Figure 1 — is also very complex. Indeed, a firm's abatement costs are a function of its current input mix, its technology of production,

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16 For pollution to exist, there should not only be physical damage, but also people whose welfare is negatively affected by the deterioration of the environment. Many ecologists argue that the environment has an intrinsic value unrelated to the utility human beings derive from it. Though one may be sympathetic to this idea, the problem then becomes that of estimating the intrinsic value.

17 Economists have developed a number of techniques to estimate the value that society may attribute to environmental degradation. Such techniques are far from perfect, but nevertheless provide us with some rough estimates. For a nontechnical survey, see D.W. Pearce, A. Markandya, and E. Barbier, *Blueprint for a Green Economy* (London: Earthscan, 1989).

the age of the plant, and numerous other factors. Moreover, the lack of appropriate resources forces the regulator to rely extensively on information supplied by the polluters themselves, who, needless to say, have no incentive to be completely forthcoming.

As a result, if environmental regulations are necessary, the maximum allowable levels of emissions of pollutant for each firm must be set in the absence of complete information.[18] The regulator thus faces a real dilemma. On the one hand, the regulator, as a custodian of the environment, has to intervene and set targets — based on current and incomplete information — to prevent further environmental degradation. On the other hand, with incomplete information on the costs of various abatement options, the regulator has to set targets at levels that will not impose too high a cost and stifle economic activities.

Canadian (and U.S.) regulators now use a technique whereby targets are set at levels that are achievable by specific types of emissions-control technologies, the most commonly used of which are "best available" and "best practicable". As discussed in the next section, this technique, as currently applied, still requires the regulator to possess information about the abatement costs of each individual firm. This opens the door to lengthy negotiations between regulator and polluters, and allows polluters to reveal strategically the information in their favor. Indeed, the current system offers polluters many opportunities for delaying the imposition of specific regulations.

Best Available and Best Practicable Technology

Canadian regulators set emissions limits based on the anticipated performance of the best practicable or best available technology. The principle is relatively simple. Suppose that, by employing either technology, a firm is able to reduce its emissions of a given pollutant,

18 This lack of information partly explains why the use of cost-benefit analysis in environmental issues has always been controversial.

X, to the level X^c. Then, using X^c as a benchmark, the regulator simply sets the maximum allowable level of emissions of pollutant X to the level X^c. In other words, the target is set at a level that the technology would allow the firm to achieve.

The major difference between best available technology (BAT) and best practicable technology (BPT) is cost. While the BAT does not, in principle, require the regulator to consider the costs of implementing the targets, the BPT requires the regulator to use a technology that is both technically and financially viable to the firm. Like their U.S. counterparts, Canadian regulators follow a systematic procedure to establish emissions limits. For example, the process followed by the Ontario Ministry of the Environment under its Municipal/Industrial Strategy Abatement (MISA) program consists of the following major steps:

> [C]onsultation with each industrial sector through joint technical committees; review of available data from various studies, monitoring programs and similar regulations in other jurisdictions; completion and review of economic studies, including the recommendations of the MISA Advisory Committee; and public review of regulations and supporting studies. Only through this rigorous process will the ministry identify and set BATEA [best available technology economically achievable — similar to best practicable technology] discharge limits.[19]

The overall regulatory process, then, may be characterized as technological, and appears to leave no ground for disputes, negotiations, or delays. Unfortunately, the lack of ambiguity is only apparent.

Consider a case where the BPT is used to set emissions limits. Before setting targets, the regulator first needs to define what is meant by a technology that is *technically and financially viable* to the

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19 Ontario, Ministry of the Environment, *Municipal/Industrial Strategy Abatement (MISA) Program* (Toronto, 1989), p. 20. For a more complete description of this procedure, see idem, *A Policy and Program Statement of the Government of Ontario on Controlling Municipal and Industrial Discharges into Surface Waters* (Toronto, 1986); and idem, *The Public Review of the MISA White Paper and the Ministry of the Environment's Response to It* (Toronto, 1987).

firm. At the very least, such terms are far from being objective, and they require the regulator to assemble a vast amount of information before being able to proceed to define the BAT or BPT for a particular firm and to set a maximum allowed emissions for that firm. On the one hand, the regulator must be aware of every existing emissions-control technology for any given pollutant. On the other hand, among all the existing technologies, the regulator has to know which ones the firm can physically and technically introduce and use, and which ones it can use without significantly reducing its profitability.

It is important to understand the heavy responsibility this approach places on the regulatory agency concerned. It has to be able to interpret a very large number of scientific and engineering data. It has to understand the specifics of the production technology used by each firm in the regulated industry.[20] It has to know the investment and expansion plans of each regulated firm. It has to be able to interpret all the financial information provided by the firm. Finally, it has to understand the particularities of the firm's domestic and foreign competition. The above requirements are set out in the Ontario's MISA program:

> The factors considered in establishing the best available technology economically achievable level of control include: the costs of applying the control technology, the age of process equipment and facilities, the process employed, process changes, the engineering aspects of applying various types of control technologies, and non-water quality environmental considerations.[21]

This is, in fact, part of the information that is also necessary to estimate the abatement-cost curve of Figure 1. Some may reject the

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20 This may explain why regulations are set at the industry level. If different firms in the same industry use more or less the same production technology, the regulator then needs to understand only the specifics of that technology in order to proceed with the regulations.

21 Ontario, Ministry of the Environment, *A Policy and Program Statement on Controlling Municipal and Industrial Discharges into Surface Waters*, p. 32. This emphasis on costs may explain and justify the dichotomy that the regulation creates between old and new sources of a given regulated industry. Indeed,...

applicability of the optimal-level-of-pollution model on the grounds that it is impossible to get a relatively fair estimate of the abatement-cost function. But we have just seen that essentially the same information is required under the current regulatory procedure. The MISA program also states that:

> the Ministry will carry out socioeconomic studies in each industrial sector to determine the impact of implementing MISA. The results of these studies will be one of the factors considered...in developing regulations.[22]

The vast amount of information that must be gathered by the regulator to define the BPT, and the "socio-economic" nature of that information leaves the door open to endless negotiations between the regulator and polluters. As one study notes:

> The costs of a range of pollution control techniques are literally specific to particular plants. The uncertainties and magnitude of this task are such that the outcome is little more than the result of a bargaining session between government and industrial management. Almost any outcome can be challenged in the courts and delayed for years.[23]

Another study, commenting more specifically on the Canadian pulp and paper industry, concludes:

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21 - *cont'd.*

> it may simply reflect the fact that it is less costly and less disruptive to adopt new emissions-control technology when the plant is still on the drawing board than to implement it in existing plants. However, it may also carry us further away from efficiency. Furthermore, the distinction between old and new sources may impede existing firms in altering or expanding their production technology so as avoid having to face stricter emissions limits.

22 Ontario, Ministry of the Environment, *The Public Review of the MISA White Paper and the Ministry of the Environment's Response to It*, p. 31.

23 E.S. Mills and P.E. Graves, *The Economics of Environmental Quality* (New York: W.W. Norton, 1986), p. 248. Although Mills and Graves refer to the U.S. experience, there is every reason to believe that the same holds for Canada.

> Best practicable technology is the best technology available given the economic realities of the mill, the market strength of the mill's products, and the commercial viability of the processes it will be adopting for use over time. As such it is a concept that cannot be measured, because it is continually changing and ultimately depends on the goals of those operating the mill over the long term.[24]

Vast amounts of time, effort, and money are thus needed (and lost) in defining and negotiating the exact terms of what is practicable for a particular firm to achieve.

Other than the resources expended at negotiation, there are at least two other important consequences of the current technological approach. First, it leaves absolutely no room for the regulator to trade off the costs and benefits of setting the targets at different levels. Indeed, basing the targets on purely technological grounds eliminates the need for the regulator to estimate the assimilative capacity of the environment and the relationship between the emissions of a pollutant and the environmental damage caused by that pollutant. The fact that technological and engineering data, compliance costs, and other socioeconomic factors are considered does not mean that the regulator balances the costs and the benefits — that is, reduction of environmental damage — of the regulations. It simply means that the firm has to be able to afford to comply with the targets. This is clearly expressed by the Ontario Ministry of the Environment: "Under no circumstances will the water quality-based assessment result in a relaxation of BPT. BPT is the baseline performance standard, irrespective of 'assimilative capacity'."[25]

Although consistent with MISA's goal of totally eliminating toxic contaminants in municipal and industrial discharges into water-

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24 W.F. Sinclair, *Controlling Pollution from Canadian Pulp and Paper Manufacturers: A Federal Perspective* (Ottawa: Environment Canada, Conservation and Protection Branch, 1990), p. 108.

25 Ontario, Ministry of the Environment, *The Public Review of the MISA White Paper and the Ministry of the Environment's Response to It*, p. 227.

ways,[26] the approach is lacking when compared with the theoretical framework presented above.[27] It allows no compromise in the form of trading off control-cost savings against a more lenient target. In my view, emissions limits for a given pollutant and industry should be a range, rather than a specific number. Depending on the particular nature, characteristics, and assimilative capacity of environment surrounding the firm, the individual limits could be set at the minimum or maximum limits of the range, or at any value within it. This would introduce a necessary element of flexibility in the process of determining emissions targets.

As Bruce Doern discusses in Chapter 1, a major advantage of market-oriented emissions-control policies — such as emissions taxation or marketable permits — over regulatory interventions is that they encourage the firm to reduce further its levels of emissions, even below the initial targets. The reason is simple: For each unit of emissions the firm abates, it avoids paying the emissions tax on that unit — or it can sell the permit it no longer needs. The firm then has a strong incentive to invest in the research and development of new, more efficient, less costly emissions-control technology. In fact, a goal of zero emissions has a better chance of success if the regulator adopts market-oriented policies.

This introduces us to the second major consequence of using a technological approach such as the BPT or BAT to define emissions limits. Once the firm complies with the specified limits, it has absolutely no incentive to do better than what is required. In

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26 This goal is a vague reminder of the 1972 amendments to the U.S. *Water Pollution Control Act*, which called for a complete elimination of all discharges of pollutants into navigable waters by 1985. The goal was obviously not reached, and one cannot anticipate the day when it will.

27 MISA does specify that the benefits of reducing present levels of pollution will be considered. My point is that not only should they be considered, they should receive as much attention as the cost aspect of the problem. Moreover, at some point society clearly will judge that the extra cost of a further reduction of emissions is not worth the gains of marginally smaller environmental damages. Hence, the requirement for considering the benefits of pollution reduction is inconsistent with the goal of totally eliminating toxic contaminants. This will probably lead to the same result as the one referred to in the previous footnote.

particular, it has no incentive to invest in the development of better emissions-control technology.

There are two reasons for this. First, the research and development of a better emissions-control technology is costly, and even if the firm were successful, its adoption would represent no cost savings. Second, if a better emissions-control technology is discovered, then there is the clear possibility that the regulator may adopt the new technology as the BPT or BAT and require the firm to achieve stricter emissions limits. The Ontario Ministry of the Environment provides the following support for this point:

> The Ministry will make a periodic review of effluent limits a requirement in the regulation. The specified period for review has not yet been determined, but it seems at this stage that five years may be too short a period to be practicable. Many factors need to be taken into account in determining an appropriate review period; these include...the rate at which new control technologies are developed and tested.[28]

If anything, under the current approach, it may be possible for firms to harbor an incentive to delay the discovery of a new technology. Implicit in the regulator's position is that, under the present technological approach, new control technologies will be developed. However, this simply ignores the fact that the development of new technologies is endogenous to the control approach chosen by the regulator. As a recent study concluded, "[t]he less the regulations concern themselves with technology, the more they facilitate technical change."[29]

No matter how emissions limits are set, the next goal of the regulator is to adopt policies that can achieve those limits. The chapter now turns to the analysis of two of these policies: performance standards and design standards.

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28 Ontario, Ministry of the Environment, *The Public Review of the MISA White Paper and the Ministry of the Environment's Response to It*, p. 25.

29 Organisation for Economic Co-operation and Development, *Economic Instruments for Environmental Protection*, p. 91.

Performance and Design Standards

This section, first, briefly describes performance and design standards, and then explains why Canadian regulators have shown a preference for using the former. This is followed by an example showing that, despite the alleged superiority of performance standards, in certain circumstances social welfare is higher under design standards. The crux of the argument relies on the difference between the private and social costs of pollution abatement.

Description and Alleged Superiority of Performance Standards

To control its level of emissions, a firm has access to a variety of different means: changing the input mix, changing the technology of production, reducing the level of output, installing emissions-control technologies, and others, depending on the firm's characteristics. When the regulator adopts a performance standard, it leaves the firm absolutely free to adopt whatever means — or combination of means — it chooses to comply with the target; the regulator only monitors the firm's performance. If, on the other hand, the regulator adopts a design standard, it instructs the firm to adopt a particular type of emissions-control technology, leaving the firm with no choice.

Contrary to U.S. environmental regulatory agencies, which have often used design standards, Canadian regulators, except for a small number of specific cases,[30] have a tendency to use performance standards:

> In Canada, legislation does not prescribe how pollution sources should reduce their emissions. Rather, the legislation sets strict

30 For example, it may happen that a firm's preferred solution to control its effluent emissions seriously worsens air or land pollution. In such cases, the regulator may intervene and impose specific emissions-control technology. Another exception considered under the MISA program is the case of volatile organic compounds, where the industry may have to use specific control technologies.

> emission targets and penalties for non-compliance. Industry is free to select the most efficient and effective means of achieving these limits. In this way, the legislation recognizes that different types of pollution sources require different types of controls.[31]

The reason for the adoption of a performance standard policy is simple to understand. Given that a firm's objective is to comply with the target at minimum costs, it follows that the polluter's cost is minimized under a performance standard. Any other policy, such as a design standard, will necessarily involve a higher cost of compliance. Indeed, it is always possible for the firm, facing a performance standard, to choose to install the same technology it would be required to install under a design standard. If it does not do so, it must be because it is less costly to do something else. One study notes that

> design standards limit the firm's flexibility. A firm that finds a cheaper or more effective way of achieving the regulation's objective must undertake the heavy burden of forcing a change in the standard before it can use its new method. It thus has diminished incentive to look for better methods. For the same reason, a design standard tends to freeze existing technology and to favor those firms already equipped with that technology over potentially innovative new competitors.
>
> A performance standard permits flexibility and change. It is directly addressed to the problem it must solved. And since the agency must, in any event, consider the comparative performance of different machines in order to write a design standard, it may be as easy for the agency to write its standard directly in terms of performance goals, such as cleaner air or fewer injuries.[32]

In short, the rationale for using a performance standard is that the polluter is better off under that policy than under a design standard.

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31 Canada, Department of the Environment, *Stopping Acid Rain* (Ottawa, 1988), p. 1.

32 S.G. Breyer, *Regulation and Its Reform* (Cambridge, Mass.: Harvard University Press, 1982), p. 105.

Furthermore, if the polluter is better off under a performance standard, it is then concluded that the *social* cost of the emissions reduction program is lower under a performance standard. This is an alleged superiority I contest. The next example shows that if a performance standard necessarily minimizes the *private* cost of the emissions-control program, it may not minimize the social cost of the program.

Performance versus Design Standards: An Example

Suppose a firm is the sole producer of a product, Q. In producing Q, it emits a pollutant, X.[33] It is assumed that the amount of X emitted (x) depends on the quantity of Q produced (q) and the quantity (or quality) of an emissions-control technology (e) that the firm can install.[34] More specifically, let

(1) $$x = \frac{Vq}{e+1}.$$

As the monopolist's level of output increases, the amount of pollution increases. As the emissions-control technology increases (in number, size, or quality), pollution falls. Note that when the firm is not

33 This example is based on D. Besanko, "Performance versus Design Standards in the Regulation of Pollution," *Journal of Public Economics* 34 (1987): 19–44; and B. Lapiante, "Design Standards versus Performance Standards with Heterogeneous Firms" (Queen's University, Kingston, Ont., 1990, Mimeographed). I will try to keep the technical aspect of the example to a minimum. Nonetheless, the reader who feels uncomfortable with the following algebra may proceed directly to the results of the simulation, presented in Table 1 and Figure 2. Readers who are interested in more detail than that presented here should refer to the above sources.

34 Note that the results are not specific to the monopolistic industry. They generalize to any number of firms. Note also that the example is not meant to reproduce in any specific way real situations. Its only purpose is to illustrate the point I wish to convey to the reader.

regulated, $e = 0$, and the amount of pollution is then solely a function of q,

(1a) $$x = Vq.$$

Let society value environmental damage by

(2) $$TD = dx^2,$$

where TD stands for Total Damage and d is some positive parameter. As the amount of pollution increases, the level of total damage increases at a faster and faster rate. The market-demand function faced by the monopolist is

(3) $$P = A - q,$$

where P is the market price and A some positive parameter. The total cost of producing good Q is of the simplest form,

(4) $$TC_q = cq,$$

where TC_q stands for Total Cost of production and c is the average (and marginal) cost of production. The total cost of using the emissions-control device is assumed to be

(5) $$TC_e = Ke,$$

where TC_e stands for Total Cost of using the emissions-control technology and K is the average (and marginal) cost of using a unit of the emissions-control device.[35]

Suppose, first, that there is no regulation. Then the monopolist simply produces the level of output that maximizes its profits. This level is obtained by solving the following problem:

35 Note that using the emissions-control technology has no effect on TC_q. It simplifies the analysis without changing the qualitative nature of the result.

(6) $$\text{Max } \pi = (A - q)\, q - cq,$$

which yields

(7) $$q^* = (A - c)/2.$$

Given this level of output, the monopolist's profits are

(8) $$\pi^* = \frac{(A - c)^2}{4},$$

and the consumers' net surplus is equal to[36]

(9) $$CS^* = \frac{(A - c)^2}{8}.$$

The level of social welfare derived from the consumption and production of good Q is simply the sum of the producer's profits (equation [8]), and the consumers' net surplus (equation [9]), net of the environmental damages that the production of Q entails. Hence, social welfare in the absence of regulation is

(10) $$SW^* = \frac{3(A - c)^2}{8} - \frac{dV^2(A - c)^2}{4}.$$

Suppose the regulator sets the maximum allowed level of emissions at $\bar{x}$. Let us first examine and calculate the impact on social welfare if the regulator uses a performance standard. In order to comply with this target, the firm can reduce its level of output and/or install the appropriate type (or quality) of emissions-control technology. Let us assume that the most profitable solution for the firm is

36 The net surplus a consumer derives from consuming a unit of good X is the difference between the maximum amount the consumer is willing to pay for a unit of X and what he actually pays — that is, the market price.

to reduce its level of output and install no control technology.[37] Then, given that $e = 0$, the monopolist has to produce

(11) $$q^p = \bar{x}/V.$$

For this level of output, the monopolist's profits are

(12) $$\pi^p = \frac{(A - c)\,\bar{x}}{V} - (\bar{x}/V)^2.$$

For any given limit $\bar{x}$ less than x^*, q^p is less than q^* and, consequently, π^p is less than π^*. The monopolist's profits thus fall on the introduction of the environmental regulation. The difference $(\pi^* - \pi^p)$ is the *polluter's* cost (the *private* cost) to comply with the emissions limit under a performance standard. But the polluter is not the only one to lose. Indeed, since there is less output available on the market, consumers also lose. The net consumer surplus under the performance standard is equal to

(13) $$CS^p = (q^p)^2/2.$$

Since q^p is less than q^*, it follows that CS^p is less than CS^*. The *social* cost of the emissions-control program under a performance standard is the sum of the reductions in the producer's profits and consumers' net surplus. The benefit is the reduction in the level of environmental damage. Social welfare under a performance standard is

(14) $$SW^p = \frac{(A - c)\,\bar{x}}{V} - \frac{(\bar{x}/v)^2}{2} - d\,(\bar{x})^2.$$

Suppose, on the other hand, that the regulator uses a design standard and thus requires the firm to use the type (or quality) of

37 This may indeed be the most profitable solution for the monopolist after considering all possible combinations of q and e that yields the required level of emissions. We assume the result simply to reduce the amount of mathematical computation.

emissions-control technology that, on proper installation and usage, allows the firm to achieve the limit $\bar{x}$. Under such a scheme, the firm has no incentive to reduce its level of output, and the necessary amount of emissions-control technology is

(15) $$\bar{e} = (Vq^*/\bar{x}) - 1.$$

Under the design standard, the *polluter's* cost is simply equal to the cost of using the emissions-control device — that is, $K\bar{e}$. Since there is no change in the level of output, consumers are as well off under the design standard than if there were no regulation. Hence, under a design standard, the *social* cost of the environmental regulation is equal to $K\bar{e}$. Social welfare is then

(16) $$SW^d = \frac{3(A-c)^2}{8} - K[(Vq^*/\bar{x}) - 1] - d(\bar{x})^2.$$

Comparing (14) and (16) allows us to say whether a performance or a design standard should be used.

For the purpose of this simple simulation, suppose that $a = 100$, $c = 10$, $K = 1{,}000$, and $d = V = 1$. Given these values, $q^* = x^* = 45$, the polluter's profits are 2,025, consumer surplus is 1,012.5, and social welfare is 1,012.5. Given that the emissions level is now 45, the regulator intervenes and set the maximum permissible level to any number between 45 and 25. Given these values, Table 1 has been computed comparing the private and social costs under a performance standard and a design standard.[38]

Notice that the polluter's cost for complying with the target is smaller if the regulator uses a performance standard. As mentioned earlier, and as several studies have shown, this is the regulator's major justification for the use of a performance standard over a design standard. Nonetheless, observe in Figure 2 that for every

38 For these values, one can show that, under a performance standard, it is indeed optimal for the polluter to reduce its level of output only to comply with the emissions limit.

Table 1

Private Costs versus Social Costs of Performance and Design Standards in Pollution Control

	Performance Standard			Design Standard
Emissions limit	**Cost to polluter**	**Cost to consumer**	**Social cost**	**Cost to polluter**
44	1	44.5	45.5	22.7
42	9	130.5	139.5	71.4
40	25	212.5	237.5	125.0
38	49	290.5	339.5	184.2
36	81	364.5	445.5	250.0
34	121	434.5	555.5	323.5
32	169	500.5	669.5	406.3
30	225	562.5	787.5	500.0
28	289	620.5	909.5	607.0
26	361	674.5	1,035.5	730.7

emissions limit considered in the example, social welfare is higher under a design standard. The reason is (as shown in Table 1) that the social cost of complying with the target is smaller under the design standard.[39]

Whether or not this example reflects a realistic situation is an empirical matter. It does demonstrate, however, the crucial difference between the *private* and the *social* cost of a policy. This implies that the regulator should not rely blindly on the use of performance standards on the simple premise that they give polluters the maximum flexibility to comply with the desired emissions limit.

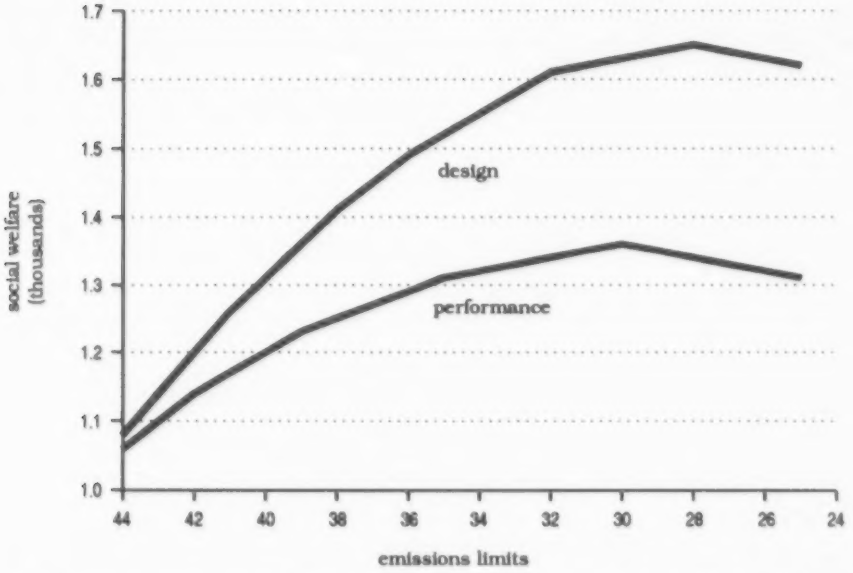
Monitoring and Enforcement of Policies

The last step of the regulatory process is to ensure that polluters comply with emissions limits. The procedure for monitoring and enforcement may, *a priori*, appear relatively easy: officials visit the

39 Under the design standard, the social cost equals the polluter's cost, since there is no loss of consumer surplus.

Figure 2

Social Welfare:
Performance versus Design Standards in Pollution Control



plant on a regular basis, preferably unannounced; following very precisely defined procedures, they take samples and have them analyzed; and firms found to be flaunting the rules are subject to prosecution and fined, as specified in the laws. Alas, the process is much more complex.[40]

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40 There is a large literature on the problems of monitoring and enforcement. See, for example, J.D. Harford, "Self-Reporting of Pollution and the Firm's Behavior under Imperfectly Enforceable Regulations," *Journal of Environmental Economics and Management* 14 (1987): 293–303; D.R. Lee, "The Economics of Enforcing Pollution Taxation," *Journal of Environmental Economics and Management* 11 (1984): 147–160; S.H. Linder and M.E. McBride, "Enforcement Costs and Regulatory Reform: The Agency and Firm Response," *Journal of Environmental Economics and Management* 11 (1984): 327–346; C.S. Russell, "Monitoring and Enforcement," in Portney, *Public Policies for Environmental Protection*; Sinclair, *Controlling Pollution from Canadian Pulp and Paper Manufacturers*.

I argued above that it is essentially the lack of appropriate information that has led the regulator to adopt the best-available and best-practicable-technology approach to set emissions limits. The problem is now one of enforcing a target in a situation where it has been set with incomplete information and where the available information has been provided by the industry itself. First, it must be stressed that the lack of resources from the public treasury prevents the regulator from implementing an extensive monitoring and enforcement program. Again, as stated in Ontario's MISA program, "[t]he Ministry will learn of effluent limit violations by the following means: dischargers will be required to notify the Ministry of violations."[41] I leave it to the reader to decide the appropriateness of a procedure that relies on the violator's turning itself in. For emissions that dissipate rapidly — such as most atmospheric pollution — or in cases where it is difficult for the regulator to identify the source of the emissions of a particular pollutant — because of a high concentration of firms producing the same pollutant — one should not expect the offender to be forthcoming.

But there is a more crucial point. Even if a violation were reported, it would be very difficult for the regulator to identify why such a firm failed to comply with the target. The reason is simple. To understand the failure of compliance, the regulator needs the same information it requires to set targets at their optimal levels. Since that information is not collected — or is only partly collected to set the BPT — the regulator cannot hope to comprehend fully the reasons for noncompliance. Is it because the firm did not work hard enough at trying to comply with the regulations? Or is it simply because compliance was impossible to begin with, given the firm's technical and financial position?[42]

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41 Ontario, Ministry of the Environment, *The Public Review of the MISA White Paper and the Ministry of the Environment's Response to It*, p. 42.

42 The regulator's inability to delineate the reasons for noncompliance may explain why the regulatory procedure involves a substantial amount of bargaining and negotiation. Given that enforcement is difficult, it may be better to sit down and negotiate with the polluters so as to increase the likelihood that they will comply "voluntarily" with the regulations.

The regulator's inability to comprehend the reasons for noncompliance has a major consequence: even under a performance standard, there may be a clear advantage for the firm to install the abatement technology equivalent to the BAT or BPT, even though these technologies are expensive and not technically suited for the firm. As one study concludes:

> Since large fines are rarely imposed on polluters, in Canada or the U.S., there is every reason for the polluter to debate the wisdom of a standard (target) once adopted, complain about the difficulties of compliance, and take no actual steps to comply so long as an appearance of a good faith attempt to comply can be maintained.[43]

What better way to maintain the "appearance of good faith" than to adopt the technologies suggested by the regulator? Since the appropriate information is not available, the regulator may be satisfied simply to observe that the suggested control technology is in place. As was noted at least in the United States — and there is *a priori* no reason to believe that it would be different in Canada: "One finding is that much more attention has been devoted to ensuring that polluters get pollution equipment in place than to seeing that it is operating correctly."[44] I noted in a previous section that, contrary to first impressions, the technological approach reduces a firm's incentive to invest in the research and development of new and more efficient emissions-control technology. This may be enhanced because of the problems faced at the enforcement stage of the current regulatory procedure. If a firm can escape prosecution simply by installing the suggested technologies, its lack of incentive to experiment and develop other technologies is understandable.

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43 D.N. Dewees, *Evaluation of Policies for Regulating Environmental Pollution*, Economic Council of Canada Working Paper 4 (Ottawa: Economic Council of Canada, 1980), p. 42.

44 Portney, *Public Policies for Environmental Protection*, p. 5.

Conclusion

The introduction of environmental regulations may at first appear to be a straightforward process. The lack of information, however, renders the process very difficult. If anything, the task of the regulator is made even more difficult by its possibly misplaced confidence in performance standards.

The purpose of any given regulations should be to meet the goals set at minimum cost. In that regard, the most fundamental question to ask is whether or not the technological approach adopted by Canadian regulators promotes economic efficiency. From a dynamic point of view, it seems likely that this approach discourages the development of better emissions-control technology. The regulator's mistake is to assume that the process of research and development is not influenced by the type of regulations adopted; quite the contrary, this development is endogenous to the government's regulatory procedure. From a static point of view, it is clear that in order to achieve any given level of environmental quality, technology-based emissions limits will result in higher costs than market-oriented policies.

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4 Regulations and Incentives: *The NOx-VOCs Case*

G. Bruce Doern

A case study of the regulation of nitrogen oxides (NOx) and volatile organic compounds (VOCs) is especially instructive in the context of this book. The NOx-VOCs case represents a point of juncture in the basic habits of federal and provincial environmental regulators. It involves a regulatory process that is currently under way and one in which the early proposals proceeded from the classic "command-and-control" instincts endemic in Canada's history of environmental regulation. The case has evolved, however, through a stakeholder consultation process that has itself generated counterproposals for the greater use of incentive approaches — in particular, tradable permits. It is, accordingly, a prototype of the contemporary dilemmas and challenges of environmental implementation and of the political-economic relationships between means and ends.

Although NOx and VOCs are air pollutants, the focus of both this case study and the federal-provincial management plan is on ground-level ozone or, generically, "urban smog" — a secondary pollutant formed by photochemical reaction between NOx and VOCs in the presence of sunlight.[1] The regulatory plan could help deal with

[1] Long Range Transport of Air Pollutants Steering Committee, *Management Plan for Nitrogen Oxides and Volatile Organic Compounds*, 1st ed. (Ottawa, March 1990).

other environmental concerns with NOx and VOCs, such as the direct toxic effects of certain VOCs, but that is not its specific purpose.

More than do the other case studies in this volume, this chapter takes the reader in some detail through the dynamics of a complex regulatory and standards-setting consultation process. While it has not yet concluded, the process is one in which regulators are making a serious attempt to correct the weaknesses of past efforts, most of which were regarded as secretive and nonconsultative in nature.[2]

With respect to matters of process, the case will draw out explicitly the dynamics of international relations, federal-provincial relations, and stakeholder relations in standards-setting and in the development of a national management plan to control NOx-VOCs emissions.

With respect to the substance of NOx-VOCs regulation, the concerns are threefold. Will such emissions be substantively reduced? Will agreed-on reductions be achieved in the most cost-effective way for society? Will the management regime adequately accommodate regional variations?

The basic chronology of the NOx-VOCs case is sketched out in Box 1. Although the proposed management plan, if adopted in the fall of 1990, will be implemented over a 15-year period in three main action phases, this case study focuses on the period between the summer of 1988 and August 1990, during which two phases of consultation with stakeholders occurred and the issue of command-and-control versus incentive approaches was debated.

A Primer on NOx and VOCs

Nitrogen oxide emissions come primarily from the combustion of fossil fuels. Emitted primarily in the form of nitric oxide, they are rapidly converted into nitrogen dioxide. Volatile organic compounds are released during combustion from various industrial processes

2 G. Bruce Doern, *Canadian Environmental Policy: Why Process Is Almost Everything*, C.D. Howe Institute Commentary 19 (Toronto: C.D. Howe Institute, 1990).

and from the evaporation of liquid fuels, solvents, and organic chemicals. It is the secondary combined effects of these pollutants, in the form of ground level ozone — a component of urban smog — that is the main concern.

Well over half of Canadians are exposed regularly in the summer months to ambient air ozone concentrations above 82 parts per billion that cause adverse health effects, including a decrease in lung function and premature aging of the lung. Several times in 1988, for example, people in major Canadian cities had to be advised to stay indoors and limit outdoor physical activity because of high ozone levels. Damage to vegetation can also occur, affecting growth and productivity. Crop damage in Ontario alone is estimated at up to $70 million per year.

More specifically, scientists have identified three areas of concern with ground-level ozone. First, there has been a general increase in "background" levels in both Canada and the world in general. Second, there has been an increase in growing-season ozone levels. Third, there is concern about short-term episodes of ozone concentrations above 82 parts per billion — lasting from hours to days — during which acceptable health and environmental concentrations are exceeded; the Lower Mainland of British Columbia, the Windsor-Quebec City corridor, and Saint John, N.B. are three areas where this has been a particular problem.

The first edition of the NOx-VOCs management plan envisions 61 specific initiatives for the reduction of NOx and VOCs emissions, and 20 studies intended to provide information for the second phase of the plan beginning in 1994.[3] Of the 61 initiatives, 23 deal with NOx and 38 with VOCs, with action plans in the areas of energy conservation and product control, consumer choice and lifestyle, and source control.

If these plans are adopted, NOx and VOCs emissions in 2005 are expected to be 16 percent and 19 percent, respectively, below their 1985 levels, with reductions of about 30 percent in key ozone

3 Long Range Transport of Air Pollutants Steering Committee, *Management Plan for Nitrogen Oxides and Volatile Organic Compounds.*

problem areas. Only modest reductions — less than 10 percent — are expected in growing-season mean ozone concentrations.

Box 1

The NOx-VOCs Chronology

1984–88
Negotiations under way on an international NOx protocol.

Summer 1988
Extremely warm summer causes severe episodes of high urban ozone levels.

October 1988
Canadian Council of Ministers of the Environment (CCME) requests the development of a management plan to control NOx-VOCs through a stakeholder consultation process.

October 31, 1988
Canada and 24 other nations sign international protocol to freeze NOx emissions at 1987 levels, to apply to new sources the best available technology that is economically achievable, and to establish further measures to solve NOx-related environmental problems by 1996.
Negotiations under way on a VOCs protocol.

April 1989
The CCME releases a summary report as background for the first phase of consultations.

July 1–September 30, 1989
The first phase of the consultation process to prepare the management plan. The focus is on scientific and technical dimensions, informing stakeholders, and identifying issues.
Two VOCs protocol discussions occur in Europe.

January 1–April 30, 1990
Second phase of consultation completed, resulting in "First Edition" — in reality, the third version — of the management plan. It proposes 61 specific measures.
Actual VOCs Protocol negotiations occur, with Canadian negotiators working within the NOx-VOCs management plan.

The plans are expected to cost $630 million per year by 2005 for emissions-reduction initiatives (mainly private-sector costs), and

another $90 million in the 1990–95 period for studies, consultations, and regulatory instruments (mainly public-sector costs). As we will see later, these cost projections are the subject of considerable dispute among participants in the regulatory process.

Box 1 - *continued*

March 1–April 30, 1990

60-day comment period, during which 5 regional information sessions and a 3-day workshop are held. Stakeholders submit 53 written briefs.

June 1990

Two further workshops held on "flexibility" — basically, tradable permits — and on the definition of VOCs.

July 1990

Second VOCs protocol negotiations occur.

Planned Stages

October 1990

Revised management plan to be considered by the CCME Deputy Ministers.

November 1990

Revised plan to be considered by environment ministers.

1991–92

VOCs protocol expected to be completed.

1991–94

If approved, management plan would require 61 emissions-control initiatives (23 NOx and 38 VOCs) and 20 study initiatives, plus detailed regulations.

1994

Second Edition of management plan scheduled.

1997

Third Edition of management plan scheduled.

2005

NOx and VOCs emissions levels to be 16 percent and 19 percent, respectively, below 1985 levels, with reduction of about 30 percent in key ozone problem areas. Targets based only on actions laid out in First Edition of management plan.

This, then, is an initial profile, a primer on the NOx-VOCs management plan that is elaborated on below. The discussion of the dynamics of the regulatory process begins with an account of the international pressures that helped put the NOx-VOCs case on the Canadian agenda.

International Pressures to Get NOx-VOCs on the Agenda

The NOx-VOCs hazard undoubtedly would have found its way on to the domestic regulatory agenda at some point in the early 1990s, because scientific opinion and local concerns about it had been evident for some time. But the issue was undoubtedly given additional impetus by the particular dynamics that often accompany the international aspects of environmental politics.[4] Increasingly, international negotiations on environmental matters are short-term media events at which countries and ministers are under pressure to keep up with their neighbors in making tough-sounding environmental commitments. This is fair game in the world of rhetorical politics and as a device to exert pressure, but it is not always the best way to solve problems.

In the mid-1980s, Canada's international credentials on the environment were very good, in part because it had played a leading role in events such as the Helsinki Protocol on Sulphur Dioxide. In this particular case, Canada's international negotiating positions were not crucial to domestic program development, because domestic policies and practices for sulphur dioxide exceeded its international obligations. This, was not the case, however, regarding NOx.

In September 1986, West Germany, Switzerland, Austria, and several other countries — under domestic pressure from their Green Parties — began to develop tougher standards on NOx emissions than those then contemplated in Canada. Many of these countries

4 See Canada, Department of the Environment, International Affairs Branch, *International Environmental Issues: A Status Report* (Ottawa, 1990).

had not had a good environmental image abroad, but new evidence showed that their forests were deteriorating badly, in part due to their own NOx emissions.[5] Now, during the NOx protocol negotiations, they began to press Canada and other countries to develop similar tough standards on NOx emissions — 30 percent reductions were called for.

Sitting in the meeting rooms at the negotiations were representatives of environmental groups, one of which issued a report critical of Canada. Although rarely interested in such usually uneventful meetings, the media quickly picked up this assessment and brought additional pressure to bear when Ontario's Minister of the Environment agreed publicly that Canada should join the 30 percent club.

This pressure, combined with Canada's relative lack of technical preparedness regarding the effects of NOx, put the international negotiators in the federal Department of the Environment (DOE) on the defensive. They did not know, for example, whether NOx was a serious problem for Canada's forests, but they did know that, in the Canadian context, NOx was important in combination with VOCs in producing urban smog. In short, DOE's strategy was somewhat ambivalent. It knew it was not as ready for NOx as it had been for sulphur dioxide, but the situation might also be used for domestic leverage and to keep pressure on the Americans, whose control actions were always essential for solving Canadian transborder problems.

Such were the dynamics in 1988. On October 31, under the ægis of the United Nations Economic Commission for Europe (ECE), Canada signed the NOx protocol, which requires it to freeze NOx emissions or transboundary flows at their 1987 level by 1994 and to implement further actions — which must be negotiated with the United States — to reduce them to the level required to achieve internationally agreed environmental quality targets. Meanwhile, the ECE had also established a working group to develop recommendations for a VOCs emissions-control protocol.

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5 See Anna Bramwell, *Ecology in the 20th Century* (New Haven: Yale University Press, 1989).

Earlier, the Canadian Council of Ministers of the Environment (CCME) and DOE had come under fire for the lack of domestic consultation regarding negotiations with the United States over acid rain.[6] Now, the energy industry roundly criticized the NOx protocol because Canada had again made commitments without much detailed consultation. Moreover, it was known that NOx-VOCs emissions would be a key part of the revisions to the U.S. *Clean Air Act* then being negotiated in Congress. Add to this the fact that the summer of 1988 was one of the hottest in years, with ozone smog episodes at their zenith in Canada, and one quickly has a recipe for quick movement up the hazard-priority ladder in environmental politics.

These pressures led to the CCME's decision, in October 1988, to launch the NOx-VOCs consultation process and to instruct its federal-provincial Long Range Transport of Air Pollutants Steering Committee (LRTAP) to develop a comprehensive plan to further manage NOx and VOCs emissions in Canada. The two main objectives were to solve Canada's domestic NOx-VOCs and related environmental problems and to meet Canada's international obligations concerning the reduction of these emissions.

Federal-Provincial Positions and Relations

The NOx-VOcs problem is no simple undertaking, as even a cursory glance at its dimensions reveals. The federal-provincial dynamics reflect this fact. Moreover, The NOx-VOCs process was occurring at precisely the same time (1989–90) when all governments were under pressure in many other aspects of environmental policy as well. This

6 See Robert B. Gibson, "Out of Control and Beyond Understanding: Acid Rain as a Political Dilemma," in Robert Paehlke and Douglas Torgerson, eds., *Managing Leviathan: Environmental Politics and the Administrative State* (Toronto: Broadview Press, 1990), pp. 243–282.

will become evident below in the brief look at the responses of Ontario and Alberta to the NOx-VOCs process.

The process as a whole was led by DOE, but the CCME's role was also pivotal. DOE was anxious to force the pace of the NOx-VOCs issue and to put pressure on those provinces that were less prepared for the task or that simply accorded it a lower priority. At the same time, DOE knew that successful action would require immense cooperation. For their part, the provinces knew that they, too, were under unprecedented political pressure and that the CCME would have to get off on the right political footing. There was little disagreement in 1988 that DOE would have to be the main coordinating entity in terms of staff, and that it would also have to be responsible for writing the report and recommendations. With significant technical input from within DOE, other federal departments, provincial environmental bodies, and industry, the core group in DOE prepared the various drafts leading to the first edition of the NOx-VOCs management plan.

This achievement in a very short period of time was quite remarkable, and is indicative of how concerted and resource intensive the task was for all players. But the first edition of the management plan is also noteworthy for the way it discussed policy instruments and for the technical complexity of the entire task.

The actions contemplated were primarily at the command-and-control end of the spectrum of policy instruments. Dozens of detailed regulations were envisaged. A further telling example of the strength of the basic command-and-control habit is found in the discussion of policy instruments. The report argued that the full range of instruments should be examined, but that they should not influence the allocation of reductions. The report stated that "it [the choice] should be made after the reductions have been allocated. Reductions should not be allocated to sources because they can be controlled by a favoured policy instrument."[7] "A favoured policy instrument" was undoubtedly a reference to the possible use of tradable permits,

7 Long Range Transport of Air Pollutants Steering Committee, *Management Plan for Nitrogen Oxides and Volatile Organic Compounds*, p.36.

as advocated mainly by economists. But the discussion of instruments also betrayed a simple view that ends and means (reductions and instruments) are politically separable when, in fact, they are not.

Thus, command-and-control habits are clearly in evidence in the plan, and were undoubtedly the dominant urge in DOE and the CCME. In fairness to both, however, it must be remembered that the political pressure they were under came mostly from political voices advocating tougher laws that then translate readily into many detailed regulations. But this instinct also arose out of the inherent technical complexity of the exercise. Much of the consultation exercise leading to the management plan was, in fact, an elaborate form of stock-taking, of matching sources and sites for remedial action and preventative action. When added to the fact that few in DOE or in other provincial ministries had ever seen a working tradable permits system up close, it is not surprising that traditional habits were in plentiful display. It is also useful to note that in the United States, despite the greater use of incentive approaches in the latter 1980s, command-and-control was still the dominant approach.

The federal-provincial aspects of the consultation exercise actually went remarkably well, in part because both levels of government needed each other and wished to show their cooperative sincerity. About one-third of the specific actions proposed would have to be taken at the provincial level, about one-quarter at the federal level, and the rest jointly through the CCME. But a brief look at the responses of Ontario and Alberta to the management plan brings out some of the emerging subtleties of positions and tactics.

Ontario's Position

Ontario's position in the NOx-VOCs case reflects three political-economic views. Though supportive of the need for action, Ontario's Ministry of the Environment was, if anything, even more ingrained in the command-and-control mode of operation than was DOE. In part, this arises out of the fact that the two environmental agencies see each other as natural rivals for political credit and blame on

environmental matters. The Toronto area and southern Ontario in general are the focal points for environmental media coverage in Canada, which exerts further competitive pressures on the two departments to be seen to be doing something on environmental issues. As a senior Ontario environmental official put it to the author: "Our approach is regulatory, plain and simple. We indicate to polluters where we have to be at a point in time." The official went on to stress that "the Canadian expectation is that we will tighten down every industry." Tradable permits were not a persuasive option in the environmental culture of the Ontario ministry.

A second feature of Ontario's approach was the combined effects of the ministry's earlier experience with its "countdown acid rain" experience. As Don Dewees shows in Chapter 6, this program, which dealt mainly with sulphur dioxide, extended over a long period in the 1980s. In contrast to Dewees' conclusions, Ontario officials saw this experience as indicative of the potential that regulatory and best-technology approaches do provide for flexibility. They knew that the NOx-VOCs case would be more complex, and that it would involve many more firms and industries than was the case for sulphur dioxide. But they believed that much flexibility could be garnered *within* the command-and-control spectrum. This, of course, is true, since economists argue (see Benoit Laplante's analysis in Chapter 3) that regulating performance rather than design standards is a superior way to proceed most of the time.

But layered over this feature was the additional fact that, in the late 1980s, Ontario had been in the midst of its own, even broader consultative process concerning its Clean Air Program.[8] One of the problems that all jurisdictions face in environmental matters is the perpetual dilemma of whether to tackle things "one hazard at a time", so to speak, or with multiple, interlocking hazards. Through the Clean Air Program process, Ontario wanted to deal with air pollution as a whole. In this sense, NOx-VOCs was a small duo. But the question was: How were they linked to other pollutants, and if one

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8 Ontario, Ministry of the Environment, *Stopping Air Pollution at Its Source* (Toronto, 1987).

took action on them, how does it help or partially foreclose action on others — economically, politically, and technologically?

Without delving into the details of the Clean Air Program initiative, the point I want to stress is that — politically and managerially — any jurisdiction will constantly experience the tug and pull of single-hazard versus comprehensive approaches. This will be especially the case in the coming decade.[9]

It must also be stressed that southern Ontario was one of the three areas that the management plan identified as having the highest concentrations of urban smog. True, the problem there was much less serious than in the worst U.S. areas — such as Los Angeles —and transboundary pollution from the United States was a major factor in Ontario's high readings. Nevertheless, Ontario was indeed the focal point for the NOx-VOCs problem as a whole.

Alberta's Position

To deal with Alberta's position in the NOx-VOCs case is to deal with a quite different political economic configuration. First, with respect to NOx-VOCs as a whole, since the management plan did not identify Alberta as a major contributor to the hazard of ground-level ozone, Alberta argued for regional flexibility and for the need to have solutions address "real problems."

Second, Alberta had a more particular concern about NOx rather than VOCs, because its dominant industry — energy — was a major source of NOx emissions and might become a particular target for discriminatory action.

As will be seen below in the account of other stakeholder reactions, Alberta, under pressure from its oil and gas lobby, had objected strongly to the lack of consultation when Canada signed the NOx protocol in 1988. Alberta was also concerned that DOE — especially under then Minister of the Environment Lucien Bouchard

9 See Paul R. Portney, ed., *Public Policies for Environmental Protection* (Washington, D.C.: Resources for the Future, 1990), chapter 8.

— might introduce an environmental carbon tax as Canada's contribution to solving the problem of global warming.

Like Ontario, however, Alberta was concurrently under unprecedented provincial political pressure to reform its environmental laws. Much of this pressure in 1989–90 centered around pulp and paper mills, but the net result was that Alberta was in the process of larger public reviews of its environmental policy as the NOx-VOCs case evolved. One involved Alberta's entire environmental legislation[10] and the other involved the Clean Air Strategy for Alberta. Significantly, the latter process was under the joint auspices of the Alberta environment and energy departments.[11] In Alberta, environmental policy is energy policy.

A final feature of Alberta's approach to the NOx-VOCs case is that provincial officials had somewhat greater sympathy for looking at economic instruments than did those in other provinces. This is not to suggest that Alberta's environmental habits were not also control oriented. But the greater sympathy for alternative approaches was the product of pressure coming from the Alberta energy industry. The nature of this pressure is best examined as part of a review of stakeholder positions and tactics.

The Positions and Tactics of Private-Sector Stakeholders

In the terminology of the CCME, the consultation process considered all governments to be stakeholders. While this section focuses on stakeholders from the private sector, it is important to appreciate the range of total participation. The participants in an April 1990 CCME workshop came from the following categories:

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10 Alberta, Department of the Environment, *Discussion Draft of the Proposed Alberta Environmental Protection and Enhancement Legislation* (Edmonton, 1990).

11 Alberta, Department of the Environment, "News Release on Clean Air Strategy Consultations" (Edmonton, March 15, 1990).

- government: 42 (31 federal, 11 provincial);
- industry: 89 (18 from associations, 71 from firms);
- environmental groups and others: 29 (16 from environmental groups and 13 others).

Later, during the 60-day commentary period on the management plan, some 53 briefs were submitted from among these participants. In addition, another 336 people were on a regular mailing list for the receipt of material on the NOx-VOCs issue.

The stakeholder exercise was modeled on DOE's evolving experience in the mid-1980s with the "Niagara process", the consultative processes devised through the work of the independent Niagara Institute.[12] Helping to steer the process was the Multi-Stakeholder Advisory Committee, which was chaired by an independent facilitator. It reported to LRTAP, which was co-chaired by two senior officials from DOE and the Ontario Ministry of the Environment. LRTAP in turn reported to the CCME deputies and then to the ministers themselves. The people who actually ran the consultation meetings and forums were from a private company, Pat Delbridge Associates. The facilitator also oversaw the participant selection process, ensuring that there was fair and balanced representation from all sectors. A separate NOx-VOCs consultation office was set up within DOE to support the overall exercise.

For their part, the participants were told to make every effort to ensure that the views they expressed at the meetings reflected those of their constituency and not just their personal opinions.

While the positions of three sectors are examined briefly below, it is important to note an outgrowth of the overall process that helped to reflect the different interests that were emerging. At the major, April 1990 workshop, various groups demanded that two further workshops be held. One examined the very definition of VOCs, and arose out of concerns by the manufacturers of cosmetics and other

12 See Glen Toner, "Whence and Whither: ENGOs, Business and the Environment" (Paper presented to a conference sponsored by the Department of Political Science, Carleton University, Ottawa, February 8-10, 1990).

products.The other workshop was on "flexibility", and is especially important for the main concerns of this chapter.

"Flexibility" covered a variety of devices, but at its core it became the surrogate name for tradable permits, as discussion at the second workshop made clear. Interests in the oil and gas and electricity industries, in particular, wanted a more thorough and sympathetic examination of the U.S. experience with tradable permits, and arranged for the National Economic Research Associates (NERA) — a U.S. consulting firm — to present not only the U.S. experience as a whole but also a prototype emission trading system, one for NOx and one for VOCs.[13]

The prototype trading system for NOx was intended to control NOx emissions from stationary sources such as utility boilers and combustion turbines. An emissions cap would be set on a regional basis, and permits would be issued specifying how much each source could emit. Trading could then occur, since sources with lower-cost capacities to reduce emissions would sell permits to those with higher costs. As a result, compared with a standard regulatory approach, the total cost of reducing emissions would be reduced.

Some concerns were, however, raised about this system. One was that it would result in higher ozone levels in some areas than others. Another was that the geographical area for trading could not be made too small or else the market for permits would be "too thin." On the whole, however, workshop participants expressed considerable support for such a system.[14]

The VOCs prototype policy was suggested as a means of controlling emissions from solvents and related uses — including,

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13 National Economic Research Associates, "Prototypical Trading Policy: Stationary Sources of NOx" (Paper prepared for NOx-VOCs Workshop on Flexible Mechanisms, Montreal, June 6–7, 1990); and idem, "Prototypical Flexible Policy: VOCs Emissions from Solvents and Related Uses" (Paper prepared for NOx-VOCs Workshop on Flexible Mechanisms, Montreal, June 6–7, 1990).

14 See Pat Delbridge Associates, *Consultation on the NOx-VOCs Management Plan: Report of the Flexibility Work Group* (Toronto: Pat Delbridge Associates, 1990).

therefore, items such as paints, personal care products, printing ink, and adhesives. It was intended to eliminate the need for hundreds of product-specific regulations. The trading system would limit the total amount of solvents used in Canada, thus capping emissions. This would increase the price of solvents and encourage product substitution and reformulation and the installation of control devices to recover solvents. For administrative convenience, permits would be issued to the 15 manufacturers of solvents rather than to the thousands of users.

The VOCs proposal elicited divided opinions from among the stakeholders at the workshop. Manufacturers of solvents favored it in principle because it would induce flexibility and, not unhappily for them, raise prices. But their costs would rise too. Users, however, opposed emissions trading on the grounds that it would increase prices and harm their competitiveness.

For most of the participants, the workshop was their first full-scale opportunity to discuss in detail a working trading system. It is interesting to note the learning curve here. Early in 1990, TransAlta Utilities Corporation, hired NERA to advise it on its NOx-VOCs brief. Later, the Canadian Electrical Association retained NERA for the workshop on flexibility. But even at this stage they were still dealing with prototypes. One result of this experience is that a separate consortium of Alberta interests and the Alberta government are funding the design of a feasibility study for a detailed trading system. DOE is also launching a feasibility study to determine the legal and institutional opportunities for such systems in Canada. As for the NOx-VOCs consultation process as a whole, the workshop on flexibility reported back on a range of proposals from pilot projects and modest flexibility checklists to a full-scale proposal to ministers that the management plan be significantly revised to make greater explicit use of emissions trading.

This discussion provides some sense of the learning curve regarding tradable permits and the broad positions of interests on the flexibility issue. It may be useful, however, to delve somewhat further into the concerns of particular special-interest groups.

Concerns of Special-Interest Groups

All the parties involved in the NOx-VOCs consultative process acknowledged difficulties in obtaining appropriate representation from environmental groups in the early stages. The reasons included a lack of expertise, varying interest in the subject among groups, a lack of funding, and an environmental lobby that was stretched thin by the numerous other environmental consultations going on in during the 1989–90 period. The main vehicle for securing representation from these groups was the Canadian Environmental Network (CEN), which formed a NOx-VOCs Consultation Caucus to share information and take part in the process.

While CEN was complimentary about the NOx-VOCs process as a whole, the first section of its brief took focused on the shortfalls of the process — including the lack of sufficient advance notice and the inadequacy of funding for such environmental nongovernmental organizations (ENGOs) as CEN itself.[15]

As to its substantive positions on NOx-VOCs, CEN advocated a major rewriting of the management plan to make it more intelligible for the public. It was clearly less sympathetic to the use of tradable permits than were some business groups, although it did support a pilot study. The essence of CEN's position was contained a statement of principles that it wished to see followed — namely, that "expensive measures (ie. retrofitting, substitution) not be overlooked in favour of reduction measures which would result in large reductions for less money. The principle of reducing emissions at source still prevails."[16]

CEN's position was to press for implementation immediately, rather than over a long period of time. It also believed that the first edition of the management plan did not deal sufficiently with the need for reductions in the United States if Canada's plans were to produce good results.

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15 Canadian Environmental Network, *Brief to the NOx-VOCs Consultation Office* (Ottawa, April 1990).

16 Ibid. p. 3.

The position taken by the Independent Petroleum Association of Canada (IPAC) — the lobby for the smaller Canadian oil and gas companies — is fairly typical of the energy industry as whole. Following its initially strong criticism of the way the original NOx protocol emerged, IPAC became genuinely complimentary of the CCME's consultative efforts on NOx-VOCs.[17] IPAC also stressed the need for complementary U.S. action and for monitoring the efforts of Canada's economic competitors to ensure their compliance with the protocol.

IPAC — and other energy interests — also drew particular attention to regional variations in the extent of the problem and, hence, in the need for regional flexibility. It stressed that "regions of Canada which are not experiencing significant concentrations of ground level ozone are being asked to implement measures as if they were." It went on to emphasize that the "requirement to conform with standards adopted to solve another regions problems, may divert available capital from addressing more serious problems, perhaps unique to each region."[18]

In the management plan, the Canadian Cosmetic, Toiletry, and Fragrance Association (CCTFA) found its industry being viewed, for the first time, as a polluter, which did not fit well with its self-image. Like others on the VOCs side of the NOx-VOCs equation, it had to be concerned about the existence of hundreds of consumer products that could be subject to detailed regulation — a level of intervention the CCTFA did not want. At the same time, it was not enamored of a trading system either, for the same reasons as those set out above.

The CCTFA drew particular attention to major weaknesses in the information and data base for designing any kind of a control system.[19] It advocated that reduction targets be based, not on some

17 Independent Petroleum Association of Canada, *Brief to the NOx-VOCs Consultation Office* (Calgary, May 1990).

18 Ibid., pp. 3–4.

19 Canadian Cosmetic, Toiletry, and Fragrance Association, *Brief to the NOx-VOCs Consultation Office* (Toronto, April 1990).

simple notion of VOCs contents, but on some formula that took into account the distinctions between reactivity, volatility, and actual emissions. The CCTFA, therefore, was among those groups that pressed for the special workshop on the definition of VOCs.

This account of the role of private-sector stakeholders in the consultation process is necessarily selective. Nevertheless, my reading of the briefs, as well as personal interviews with several of the participants, leads me to conclude that most groups found the processes of consultation to be quite good. Care was taken to consider many alternative viewpoints in a very complex political, economic, and technical problem.

Conclusions

The story of the NOx-VOCs case is not yet complete, of course. In particular, it remains to be seen whether the use of tradable permits will receive significant support in the final draft of the management plan or whether only symbolic gestures in that direction will materialize. It is possible, however, to offer some summary views of five key issues that emerged from the process so far: the role of tradable permits as a complement to traditional regulation; the role of cost factors in standards-setting processes; the issue of regional variation; the problem of single versus multiple hazards; and the consultation process.

There is considerable evidence to suggest that tradable permits should be used extensively in the NOx-VOCs control program. But this will take some time and goodwill. This does, however, present something of a paradox for regulators. The logic of tradable permits demands that they be designed from the outset as reduction levels are devised, rather than added later. One can make a good case that the tougher the standards, the better the trading system if the two are designed together. But most players are still only beginning to understand how such permits might work, while others are suspicious. The likely outcome is that only sideshow demonstration devices will be concocted. As a result, the overall plan will be far more

costly than it needs to be without any demonstrable improvement in reduction levels.

There is certainly little doubt that the NOx-VOCs management plan is composed primarily of detailed regulatory measures. Although the plan mentions the concept of cost-effectiveness, this is certainly not one of its central objectives. Given the variety of concurrent and overlapping demands that Canada is likely to face regarding other hazards, the goal of minimizing social cost should be a top priority in all such exercises.

With respect to national versus regional issues, there is little doubt that the plan is punctuated with many national rules. Again, the plan acknowledges the importance of regional flexibility and it advocates many regional actions, but not usually in the concrete standards-setting measures. The reason for the plan's greater practical recognition of variations in regional standards is not to produce second-class "NOx-VOCs environmental citizens". Rather, it is to ensure that Albertans or Quebecers are able to produce first-class environmental protection for the particular array of hazards that their political economies face, while at the same time addressing reasonable national and international priorities. The choice is not between traditional regulations that will produce equal results across Canada (they usually do not) and market-based systems that have fewer regional standards. Instead, it is between mixes of regulation and incentives that must discriminate among hazards and regions, to solve environmental problems and to do so at the least social cost.

The NOx-VOCs case also exhibits some of the genuine dilemmas that regulators and the regulated face over the issue of single versus multiple hazards. Canada's previous experience with sulphur dioxide was relatively simple compared with the NOx-VOCs duo. But what is done in the name of NOx-VOCs has implications for what might be done now and later in air pollution as a whole. Moreover, concerns about what might happen next color concerns about what ought to be done now, since many of the same industries are involved in an array of pollutants. In principle, though, the more integrated

the pollution problem and the more it is a result of a multiplicity of hazards, the more likely that tradable permits and other incentive-based approaches will be needed as a complement to rules and regulations.

As to stakeholder consultation in environmental regulation, there is little doubt that the means are as important as the ends. As much care and commitment of resources must be put into the stakeholder consultation process as into the technical base for the regulatory response itself. Without it, there is little hope of environmental progress, domestically or internationally.

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5 The Implementation of Canadian Policies to Protect the Ozone layer

Douglas A. Smith

In recent years, technical and scientific knowledge about a variety of environmental problems has increased significantly. Some of the most serious and difficult environmental problems about which we have developed new information have turned out to be international problems, as in the case of acid rain, or global problems, as in the case of the stratospheric ozone layer and the greenhouse effect.

In contrast to the increasingly international character of these problems, most pollution-control policies were developed for an earlier generation of local environmental problems. Local air and water pollution problems, in particular, have been the subject of direct regulation to meet local standards. A regulatory approach that focuses on what particular polluters must do to meet environmental regulations is referred to as a "command-and-control" system. The usual analogy is that this constitutes central planning as applied to the environment. This chapter investigates the extent to which alternative control policies based on the use of economic incentives may be able to generate the same or greater environmental gains at a lower cost in terms of the resources required to achieve these gains.

The primary focus of the chapter is on the implementation of Canadian policies to protect the stratospheric ozone layer. The framework for these policies is based on the use of economic incentives, although other approaches are being considered as well. In

spite of a variety of difficulties, the Canadian control policies reviewed here can be characterized as successful. The chapter reviews the reasons for this success, and assesses the potential for using related approaches to solve other environmental problems.

The major difficulties in dealing with the current generation of international and global environmental problems are, first, scientific uncertainty about their effects and, second, the need for agreements among many governments to deal with them. Economists refer to this latter difficulty as the "free-rider" problem, since costly controls are necessary to achieve improvements, and countries that fail to institute controls will receive some of the benefits resulting from the efforts of others.

Scientific uncertainty is a difficult issue because uncertainty means that it is always possible to argue that better policies can be developed by waiting until a broader scientific consensus emerges. Unfortunately, there are costs as well as benefits associated with waiting, and sometimes these costs and benefits cannot be measured with enough accuracy to be useful. In the case of the destruction of the ozone layer, however, there has been sufficient convergence of scientific opinion to provide the basis for useful assessments of costs and benefits.

The potential contributions of economic analysis in the development of more effective environmental policies are in two dimensions. The first relates to the extent to which we choose to devote limited resources to environmental objectives or to other ends such as education or health care. By implication, this point also deals with the way in which we divide our efforts among different environmental issues once we have decided on the level of expenditure on the environment. The second dimension in which economics may be able to contribute relates to the specific policies or instruments chosen to meet the specified objectives. Traditionally, local environmental problems have been met with direct, command-and-control regulatory policies. Such policies, however, ignore differences among polluters in control costs. As a result, pollution reduction generally will not be reached in the least costly way.

As environmental problems become more important, the incentive to develop better pollution-control policies should increase. Lessons from the Canadian experience with policies to protect the ozone layer may be a useful case study that can be applied to other areas where similar market-oriented mechanisms may contribute to environmental improvement.

The Destruction of Stratospheric Ozone

A substantial body of scientific opinion attributes much of the destruction of the stratospheric ozone layer to emissions of chlorofluorocarbons (CFCs) and halons. Halons are brominated fluorocarbons used in Canada exclusively as extinguishing agents in portable fire extinguishers and in fixed fire-suppression systems. CFCs have a variety of uses, and Canadian patterns of this use are shown in Table 1. While the uses of halons are small relative to those of CFCs on the basis of weight, they have an ozone-depletion potential that ranges from three to as much as 30 times that of CFCs.

The stratospheric ozone layer is a shield located approximately six to 30 miles above the surface of the earth. The ozone layer reduces the amount of harmful ultraviolet (UV) radiation that reaches the earth from the sun. There is no direct relationship between beneficial upper-atmosphere ozone and the polluting ozone found at low levels — usually as a result of vehicle emissions.

The problems associated with ozone destruction begin with emissions of CFCs and halons. These chemicals are extremely stable and, as a result, do not contribute to local environmental or health and safety problems in the workplace. Less stable chemical substances react chemically at low levels, but the stability of CFCs and halons means that as they are released from a variety of industrial sources, they migrate to the stratosphere, where they decompose only when exposed to the intensity of the sun at this level. The strength of the UV radiation in the stratosphere causes the substances to break down, releasing chlorine from CFCs and bromine

Table 1

Estimated Uses of CFCs in Canada, 1989

Application	Percentage of total use
Aerosol propellants	1%
Rigid and flexible foams	38
Refrigeration and air conditioning	45
Solvents	12
Other uses	4

Source: Canada, Parliament, House of Commons, Standing Committee on the Environment, *Deadly Releases: CFCs* (Ottawa, June 1990), p. 19.

from halons. In the upper atmosphere, chlorine and bromine interact with the ozone to produce chlorine monoxide, bromine monoxide, and oxygen. Chlorine and bromine are then released from the monoxide again and attack more ozone molecules. Each atom of bromine or chlorine can destroy anywhere between 10,000 and 100,000 ozone molecules.

The Montreal Protocol

Policies to protect the ozone layer began in North America in the 1970s, with regulations limiting the use of CFCs in some aerosol applications. In 1985, the Vienna Convention established international monitoring and scientific assessment activities, but did not include consumption restrictions. Current international policies to reduce and ultimately phase out the consumption of CFCs and halons have as their basis the 1987 Montreal Protocol on Substances that Deplete the Ozone Layer, which was signed by 32 nations — including the members of the European Community, which account for more than 85 percent of the world consumption of CFCs and halons. In Canada, the consumption-reduction restrictions of the Protocol commenced on July 1, 1989.

The Protocol constituted a successful attempt by the international community to develop an agreement that would deal with the

free-rider problem. This was achieved through the inclusion of provisions for trade sanctions against countries that do not participate. The Protocol also included special provisions to make the agreement more attractive to developing countries, such as a slower reduction schedule and the possibility of financial assistance from the developed countries — the mechanics of this financial assistance package, however, remain to be worked out in detail.

Under the terms of the Protocol, a schedule was established for reducing the consumption of CFCs and halons, as follows:[1]

- reduce consumption of CFCs in 1989–90 to 1986 consumption levels;
- reduce consumption of CFCs in 1993–94 to 80 percent of 1986 levels;
- reduce consumption of CFCs in 1998–99 to 50 percent of 1986 levels;
- freeze consumption of halons in 1992 at 1986 levels.

The Protocol also included provisions for continuing scientific assessment and revision of the agreement as warranted by new evidence on costs and benefits. The first such revision took place at the June 1990 meeting of the parties in London, which saw an acceleration of the reduction schedule. Controlled CFCs will now be reduced to 50 percent of 1986 levels by 1995, to 15 percent by 1997, and will be phased out entirely by 2000. Halons will be cut to 50 percent by 1995 and also phased out by 2000.

The Protocol does not individually control specific CFCs — such as CFC-12, which is used in many refrigeration applications. Instead, since each CFC has a different ozone-depleting potential (ODP), the Protocol restricts consumption based on the total ODP of

1 CFCs that are currently regulated are those with the greatest potential to deplete the ozone layer. The CFCs referred to in this chapter are CFC-11, CFC-12, CFC-113, CFC-114, and CFC-115. The regulated halons are 1211, 1301 and 2402. The numbers following the CFCs and halons describe the chemical composition of each substance. The 1990 amendments to the Montreal Protocol added menthyl chloroform and carbon tetrachloride to this list.

CFCs actually consumed. This decision to regulate overall ODP in separate consumption baskets for CFCs — and for halons as well —was the first step in allowing market forces to determine how the Protocol-mandated reductions would take place.

The Protocol requires signatory nations to develop plans to meet its consumption-reduction requirements. In Canada and the United States, regulatory initiatives of this kind now require some kind of impact-assessment statement, including consideration of the costs and benefits of the proposed regulation. As a result, there are now some quantitative assessments of the likely costs and benefits of participating in the Protocol.

The benefit-cost models prepared for the Canadian Department of the Environment (DOE) and for the U.S. Environmental Protection Agency include a series of links from CFC reductions to health effects on the benefit side, as well as models of cost effects.[2] The Canadian results measure control costs and health benefits in a model covering the years 1989 to 2075. The ratio of benefits to costs varies according to the specific assumptions that are made about the discount rate and other parameters, but net benefits are always very large. The model results are not very sensitive to different statistical values for the health effects considered or for other model parameters.

Canada's Implementation of the Montreal Protocol

Costs and Benefits of Control Policies

The quantitative assessments of the costs and benefits of the Montreal Protocol for Canadians provide the context for this country's control policies. It should be clear, however, that neither costs nor benefits are necessarily measured with a high degree of precision.

2 For details of these estimates for Canada, see Douglas A. Smith and Keith Vodden, "Global Environmental Policy: The Case of Ozone Depletion," *Canadian Public Policy* 16 (December 1989): 413–423.

On the cost side, for example, estimates incorporate only the technology available at the time. In fact, all of the evidence accumulated so far suggests that most industries that use CFCs and halons have developed new reduction approaches that appear to allow targets to be met more easily than was originally expected.

On the benefit side, the models must capture all of the links from reduced consumption of CFCs and halons to reduced ozone destruction, to less UV radiation reaching the earth, and from there to health and other effects. In spite of these uncertainties, the estimated benefits of reducing the consumption of CFCs and halons are large.

The models used in the measurement of Protocol benefits and costs assume that firms make cost-minimizing adjustments in response to the reduced availability of and higher prices for CFCs and halons. However, the actual adjustments made by firms and the costs associated with those adjustments will depend on the nature of the control policies introduced to meet Canadian commitments under the Protocol.

The Protocol made the use of a market-oriented approach to pollution control more likely. Based on a review of earlier Canadian environmental policy initiatives, it would have been reasonable to predict that some form of command-and-control mechanism would have been employed for CFCs and halons. However, the Protocol did not focus on the mechanisms for reducing consumption of CFCs and halons, but dealt instead with targets. The Protocol was an agreement to freeze consumption of CFCs initially at 1986 levels and then to reduce consumption in a series of steps to achieve a target of 50 percent of the 1986 benchmark by 1998. Economic or market-oriented approaches fit well with the Protocol, because they also focus on targets, not on the specifics of how these targets are reached.

As indicated, a review of past Canadian environmental policy would likely suggest that government would be involved not only in establishing the target but also in determining how that target was to be achieved. For example, in the case of a year in which a

20 percent reduction in CFCs is required, government could mandate the use of specific new technologies to achieve this reduction, or it could impose across-the-board consumption reductions on all users. In my view, DOE's decision not to proceed in this manner in the case of the Protocol constitutes an improved approach to environmental policy and one with the potential for application to other environmental problems.

As noted above, two of the most frequently observed components of command-and-control policies are mandates to use "best available technologies" and requirements to conform to standards that do not vary across firms. Uniform percentage reductions in the consumption of CFCs would be the standard example of this latter policy. These approaches would generate substantial economic inefficiency costs except in the unlikely special case in which all firms face identical control costs in meeting these requirements. The greater the actual cost differences across firms, the larger the inefficiency costs relative to an approach that concentrates the reductions where they can be achieved at least cost.

The market-oriented approach to pollution control can be demonstrated most clearly by considering pollution reduction as a commodity — and, given the recent growth of concern about the environment, one that the public now values more highly. If control costs differ as described above, then the desired pollution reduction should be produced by firms with the lowest costs. Failing to do so means that a given expenditure on pollution control generates fewer environmental improvements than if carried out efficiently.

To economists, this point seems so simple as to be obvious. Yet, environmentalists and many policymakers seem reluctant to adopt efficient policies, instead preferring command-and-control of one kind or another. It is clear why environmentalists, in particular, may want to spend more on the environment than does the tax-paying public, but they should share the objective of getting the maximum pollution reduction for their money. Environmentalists' opposition to this approach stems from the fact that some firms may be allowed to continue to pollute as long as the reductions by all other firms are

large enough to achieve the target. For economists and others who favor more efficient control policies, the task is to persuade environmentalists that market approaches do not reflect a reduced commitment to environmental goals.

This discussion of market-oriented approaches is simplified to the extent that it assumes that the location of pollution reductions is unimportant. If, however, the pollution problem — smog, for example — is local, then a reduction by a firm far from the center of the smog zone cannot be traded off against the continuing emissions of a firm at the center of the zone. In such cases, the market approach must be tailored to the specific locations in which the emissions generate costs. The nature of the pollutants involved, the distribution of polluting firms, and the nature of the control strategy selected will all affect the costs of a market-based system. In circumstances where these costs are very high, some forms of command-and-control may be preferable. This choice of control approaches requires careful analysis of market and alternative policies, rather than the presumptions of the past that command-and-control should always be used.

With regard to substances that contribute to global warming and the destruction of the ozone layer, total emissions have worldwide implications and so the actual locations of emissions and emissions reductions do not matter. In these cases, efficiency-promoting trades among polluters are irrelevant from an environmental point of view.

Choosing the Right Policies for Efficient Pollution Control

The Montreal Protocol established clear, quantitative targets for reductions in the consumption of CFCs and halons, which appear to have been instrumental in the successful introduction of market-oriented control policies in Canada.

The first step was to freeze the consumption of CFCs and halons in 1989 at 1986 levels. DOE achieved this by limiting producers and importers to their 1986 quantities — in effect, by establishing a

quota. This quota conceivably could have been auctioned off instead, but the key to efficiency is in the quota's transferability, not in the identity of the quota recipient when the system begins.

Key to Canada's approach to implementing the Protocol is that individual firms are not mandated to achieve specific reductions in their consumption of CFCs and halons. The total quantity available for sale is limited, so that a particular firm could even increase its consumption as long as other firms reduce theirs. The mechanism for consumption reductions is the price system. Even though economic growth has increased the demand for CFCs since 1986, available quantities are limited to their 1986 levels. The resulting price increases for CFCs squeeze out of the market those users for which control costs are less than the costs of paying more for CFCs.

The specific mechanisms of the transferability aspects of the Canadian control system are worthy of note. To start with, there are no restrictions at all on the consumption of specific CFCs or halons. Instead, since the objective is to preserve the ozone layer, restrictions have been imposed based on the ozone depletion potential of these pollutants. Producers and importers are able to substitute freely among CFCs and halons, each of which has a different ODP, as long as their total "baskets" meet their ODP quota. For example, CFC-12, which is used in refrigeration applications, has an ODP index of 1.0, while CFC-113, which is used to clean computer circuit boards, has an ODP of 0.8. A firm that produced, say, 100 units of CFC-12 and 200 units of CFC-113 in 1986 would have been limited to the production of 260 ODP units of these CFCs beginning in July 1989. The firm would be free, for example, to increase its CFC-12 output in 1989 to 260 units as long as it reduced its output of CFC-113 to zero. Producers and importers can trade among controlled substances as long as the overall ODP constraint is met.

The key element of transferability, however, relates to firms that use CFCs as inputs. Again, no specific consumption limit exists for such firms. Instead, producers are able to allocate restricted quantities according to market demands. Some sectors have limited control options and continue to consume large quantities of CFCs,

while others have been able to reduce significantly and, in some cases, to eliminate CFC use entirely. There is essentially complete transferability of CFCs in terms of their use in specific sectors. In operational terms, this result is achieved because producers are allowed to sell whatever quantities they wish to the highest bidder, again subject only to the constraint of their ODP quota.

Transferability of CFCs among users is now complete, but the existing control regime does limit transferability among producers and also prevents the transfer of ODP units between the CFC basket and the halon basket. What are the likely efficiency consequences of these limitations?

As a hypothetical example, assume that there are two producers and that producer A has a quota of 1,000 ODP units and producer B a quota of 1,500 ODP units. Complete transferability among producers would allow producer B to increase output to 2,000 ODP units if producer A were to reduce output to 500 units. In some circumstances, this reallocation of production among firms might be more efficient. In fact, the costs of this limitation are likely to be small. Consider the Protocol's requirement that consumption be reduced to 50 percent of 1986 levels. In this case, both producer A and producer B could be producing CFC-12 and CFC-113 in plants that are running at 50 percent of capacity, but they are unable to trade directly with each other. However, within the Protocol's basket approach, it would be possible to rationalize if firm A produced only CFC-12 and firm B produced only CFC-113. In other circumstances, however, there could be costs associated with the excess capacity resulting from the restricted transferability among producers. This effect would appear to be small relative to the impact of similar restrictions on the user side of the market. The lack of transferability between the halon ODP basket and the CFC basket is likely explained by the different time paths for reductions of these substances. My own assessment is that the degree of transferability is high in the dimension where it is most important, and that this transferability provides an efficiency-enhancing method for limiting consumption in Canada.

Going Beyond the Protocol: Mixed Strategies

Continuing scientific assessment of the effects of CFCs and halons on the ozone layer indicated that control measures beyond those of the Montreal Protocol were necessary to stabilize the ozone layer. Accordingly, at a meeting in June 1990, the signatories decided to strengthen the Protocol, even though Canada and other countries had already adopted targets that went beyond the Protocol. The current Canadian target is more stringent than even the revised Protocol. How should these reductions be achieved?

It would seem reasonable that the same control policies used to meet the Protocol's initial requirements should also be used to meet the new objectives. For example, if the Protocol requires a 20 percent reduction in a specific year, then the existing regulatory framework simply reduces the quantity that can be consumed in that year by 20 percent by reducing the quotas of producers and importers. Market responses determine which users actually end up changing their consumption. If a larger reduction — say, 40 percent — is required to meet a more stringent target, then the best approach would be to reduce the quotas described above by a larger amount.

Another possible approach would be to ban the use of CFCs and halons in particular applications. How would such controls work, and how do they relate to the market-oriented controls that are in place now?

Suppose that CFCs are banned in the production of, for example, rigid foams — which are used for insulation and in which CFCs act as a blowing agent that affects their energy efficiency, among other properties. Users of these products have a variety of other insulation options, including products made without CFCs. For some users, the cost of switching to alternative products is very low, while for others the cost of being unable to use products made with CFCs is very high. By 1994, all of these rigid foam products will have been converted to processes that do not use CFCs as a blowing agent. What would be the consequences of a product ban now?

Since users have different costs in finding substitutes for the CFC-based products, they will be willing to pay different prices to continue using CFCs. If low-cost alternatives are available, the user will not be willing to pay much more than the existing price to use the product containing CFCs. A user with fewer and more costly options should be willing to pay much more than the existing price.

For example, one kind of rigid foam containing CFCs — rigid polyurethane insulation — now constitutes part of the structural support in the walls of refrigerators. It also contributes to meeting mandatory energy-efficiency standards for home appliances. For both of these reasons, alternative insulating materials — such as fiberglass — are not compatible with existing designs. Accordingly, the willingness of refrigerator manufacturers to pay to be able to continue using existing products until effective non-CFC substitutes are available in 1994 will be very high indeed. This is not to say that it is technically impossible to produce a refrigerator without CFC-based insulation; fiberglass was used in the past and could be used again However, the costs of returning to the old technology would be extremely high, and it would be difficult to meet energy-efficiency requirements.

Economists measure the cost of this type of product ban in terms of the consumers' lost surplus on units of CFC-based products that are no longer produced due to the ban. This lost surplus measures the costs of switching to the next best alternatives precisely because it shows what users would be willing to pay not to have to switch. A product ban is a blunt and costly policy instrument, because it affects all users of the banned product in the same way. There may be some superficial equity in such an approach, but if users have substantially different costs of adapting to the ban, there will be little equity and certainly little efficiency in the resulting adjustments.

Continuing with our hypothetical ban on rigid polyurethane insulation, assume that it would reduce Canadian consumption of CFCs by 10 percent, and that this reduction would be in addition to any other reduction requirements that are in force. The cost of this

10 percent reduction is the sum of the costs that will be incurred by all existing users. For some, the costs are very small; for others, such as refrigerator manufacturers, the costs are very high. The same consumption reduction could be achieved by simply reducing the available quotas of producers and importers by 10 percent.

In the case of a 10 percent reduction in the available supply of CFCs, the price of CFCs would increase and some users of rigid foam would be priced out of the market. Those with high control costs could, however, continue to buy and use these products. A series of smaller reductions would be observed in all sectors, instead of complete elimination in one sector. This approach concentrates the reductions where their costs are smallest and avoids entirely the situation in which users with high control costs are forced to switch. The market, in fact, acts to seek out the users with the lowest costs of reducing CFCs in a way that would be very difficult to emulate through direct regulations if cost differences are widespread.

There are exceptions to this general point. For example, if the government has detailed information on control costs and knows that one particular area has lower control costs than all other sectors, then a ban in this area may be a better option if the costs of administering the ban are low relative to the costs of administering further quota reductions. Product bans will also not generate any excess costs if all firms face constant and equal control-cost schedules. Most empirical studies, however, indicate clearly that control costs rise as the stringency of controls increases. As a result, a ban when control costs increase with stringency will necessarily impose economic inefficiency costs.

The other circumstance in which more direct intervention may be desirable is in the case of sectors that use CFCs and halons where normal market forces do not operate. Government itself, for example, is a major user of fire-fighting halons to protect historical artifacts in the National Gallery, in computer installations, and in a wide variety of military applications. Direct policies are likely desirable here. A related example deals with the use of sterilant gas that is blended with CFCs and used in Canadian hospitals. The provincial

funding mechanisms for hospitals divide capital and current expenditure budgets in a way that may prevent the best response pattern to higher CFC prices in these nonmarket institutions. The sterilant example constitutes only a very small fraction of Canadian CFC use, but the federal government has been the largest single Canadian user of halons.

At this point, DOE has not revealed its complete set of approaches to achieving the consumption-reduction targets for CFCs and halons, although it is facing pressure from some environmental groups to proceed with product bans. This pressure is heightened by the actions of various provincial and local governments that implement such policies on their own, frequently without much analysis of their potential consequences. In other words, there are often strong political pressures to institute specific control policies, such as a product ban, that do not pass an economic efficiency test. The more desirable approach to achieving the same CFC-reduction objective is to focus on the target of reduced CFC consumption, rather than on the mechanics of the reduction process or the identities of specific users.

A government that wishes to use efficient control policies must focus public attention and debate on the targets to be achieved. As control mechanisms actually reduce consumption of CFCs, the emphasis must be on achieving the target and establishing new targets if the evidence suggests that this is desirable. Until environmentalists accept the economic approach of focusing on targets instead of processes, governments will continue to face pressures to adopt inefficient policies. Economists argue that governments should try to resist such pressures through focusing on targets, because efficient policies allow more environmental improvement for the same commitment of resources.

For control measures to go beyond the Montreal Protocol, the data that are currently available on industry experience provide clear conclusions. Most using industries are adapting rapidly and can meet accelerated standards at a moderate cost. The best control policies for DOE are those presently in place, although they should

be adjusted to reduce consumption even faster than required by Canada's international obligations. Any other approach will increase the overall costs of meeting the reduction objectives, and will force unnecessary economic hardship on some users.

Conclusions

Canadian policies chosen to implement the consumption-reduction requirements of the Montreal Protocol for CFCs and halons provide a clear example of the effectiveness of market-oriented environmental policies. The controls have been successful in reducing consumption, and control costs have been distributed efficiently among users. In fact, initial evidence suggests that the private sector is exceeding the Protocol's consumption-reduction requirements. There are two explanations for this.

First, if control measures or technologies are indivisible, then firms may reduce CFC use in discrete steps rather than continuously. Second, firms that continue to use CFCs in the face of increasing consumer preference for "ozone-friendly" products, even when such products are priced at a premium, may have costs that are higher than those of just the cost of the chemicals used.

One important element of the ozone issue as an environmental problem contributed importantly to the success of these policies in their quota form. The extent of destruction of stratospheric ozone depends only on the total quantity of emissions measured in ODP units. The damage done would be no different if all current Canadian emissions came from a single industry or location instead of the existing, widely dispersed pattern. This means that the government, in establishing control policies, does not need to know the specific sources of emissions, their location, or the type of CFC used. Only the total quantity of ODP units is relevant. This made possible the specific set of market-oriented policies that has been adopted — namely, global Canadian quotas for ODP from the use of CFCs. In the case of other pollutants in which the location does matter — as in the case of smog produced by vehicle emissions — approaches

based on market incentives can still be used, but they may be administratively more complex to implement.

The key to the success of the control policies for CFCs and halons adopted in Canada is ability of users to transfer among themselves the right to use limited quantities of these chemicals. In simplest terms, the policies consist of an auction-like procedure for quotas allocated to the firms that produce and import CFCs and halons. The role of the government is simply to determine the quantities that the producers are allowed to auction off in each time period and to monitor overall consumption totals to ensure that each firm complies. By its nature, this type of auction allocates limited supplies to those users who are willing to pay the most. This is efficient, because users with the greatest willingness to pay will be those for which the costs of doing without this input are greatest. In other words, this promotes the efficient achievement of the desired pollution-reduction target by reducing use where the costs of those reductions are smallest.

The experience with economic incentives to preserve the ozone layer should lead to a review of a wide range of existing environmental policies to determine other potential areas of application for market-based instruments. In addition, future pollution-control strategies should be considered in terms of the potential applicability of market-based instruments. The clearest case in which the lessons from the ozone issue are likely to be relevant has to do with the greenhouse effect, since in both cases it is the total quantity of emissions, rather than their location, that determines the extent of environmental damage. In the case of the greenhouse effect, emissions from different sources must again be measured in terms of a standard unit — referred to as their "global warming potential".

In other dimensions, the greenhouse effect is a more difficult policy problem. In spite of substantial research, there remains widespread uncertainty among reputable scientists about the extent to which global warming is actually taking place. The currently accepted view is that continuing current trends for the emissions of greenhouse gases will lead to an increase in the mean global tem-

perature of somewhere between 1.5 and 4.5 degrees Celsius. If scientists knew with certainty that the latter estimate was correct, it would then be clear that a wide variety of control policies would be desirable. On the other hand, if the increase is at the bottom of this range — which is still a substantial warming effect — the effects and the desirable control measures would be much different.

This uncertainty has led a number of economists, including noted Yale University economist William Nordhaus, to argue that the best current policies would be much more limited than those suggested by some environmentalists.[3] Nordhaus would focus on reducing CFC use quickly — since these chemicals are also potent greenhouse gases — more climate research, more research and development in the area of new energy technologies, economic incentives to end many inefficient forest-management policies, and a relatively modest carbon tax.

From the point of view of this chapter, the key point is that whatever control policies are introduced to deal with greenhouse gases, their design should concentrate emission reductions where they can be achieved at least cost. This is not technically impossible to achieve through a system of command-and-control, but the best that such a system can do is to mimic the result that would be observed through the price system. All of the evidence accumulated to date indicates that an incentive-based system would be far superior in the case of global warming.

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Smith, Douglas A., and Keith Vodden, "Global Environmental Policy: The Case of Ozone Depletion," *Canadian Public Policy* 16 (December 1989).

3 William D. Nordhaus, "Greenhouse Economics," *The Economist* 316 (No. 7662, July 1990): 21–24.

6 The Regulation of Sulphur Dioxide in Ontario

Donald N. Dewees

Ontario has known since the turn of the century about the damage that may be caused by sulphur dioxide fumes.[1] In 1901, a reporter from Toronto who travelled to the Sudbury area, where nickel and copper ores were mined and roasted, described Copper Cliff:

> To the eye Copper Cliff is one of the most unattractive places under the sun, for the sulphur fumes from the beds where its nickel ore is "roasted" have destroyed vegetation in the whole locality, leaving the rocky hills bare of trees and the streets and lawns innocent of a blade of grass.[2]

During the first quarter of the century, these huge heaps of smoldering ore and logs discharged high concentrations of pollution at ground level, which drifted along the ground with the wind, damaging crops and other vegetation in the local area. Local farmers received some payment for their crop damage from the mining and

1 The research presented in this chapter was supported in part by a grant from the Social Sciences and Humanities Research Council of Canada. Able assistance was provided by Alberto Isgut.

2 "Manitoulin and North Shore Railway: Mining and Farming in Algoma," *Globe* (Toronto), October 12, 1901, p. 4.

smelting companies,[3] but there seemed to be little awareness of the long-term environmental harm that was occurring. A Royal Commission examining the industry referred to agricultural damage and nuisance, but mentioned neither human health nor long-term environmental harm.[4] Later, sulphur oxides arose from smelter chimneys, from coal-fired power plants, and from the chimneys of residences and other buildings where coal was burned for winter heat. Twice as heavy as air, the pollution — especially from low temperature sources such as homes — did not rise high, but quickly reached ground level, affecting the population and environment near the source. This caused property damage, crop damage, and health effects. Sulphur oxides were implicated in killer smogs in Donora, Pennsylvania, in 1948 and in London, particularly in 1956.[5]

In urban areas, home heating with coal was banned or phased out in favor of cleaner and more convenient gas or oil between World War II and 1960. Between the mid-1960s and the mid-1970s, in response to local pollution concerns and emerging air-quality regulations, industrial sulphur dioxide sources built tall stacks all across North America.[6] The discharge of sulphur dioxide from an altitude of 500 to 1,000 feet carried it beyond the local area, reducing ground-level concentrations. This did not, however, reduce total emissions. The resulting longer residence time in the air allowed the gas to mix with moisture and become acid rain, which can harm aquatic and terrestrial ecosystems.

Today, concern about sulphur dioxide emissions arises first from acid rain and its ecological effects, second from the health

3 M. Bray, "The Province of Ontario and the Problem of Sulphur Fumes Emissions in the Sudbury District: An Historical Perspective," *Laurentian University Review* 16 (1984).

4 Royal Ontario Nickel Commission, *Report* (Toronto, March 19, 1917, by Order-in-Council 77/79), chapter 11.

5 B.A. Ackerman and W.T. Hassler, *Clean Coal, Dirty Air* (New Haven: Yale University Press, 1981), p. 61.

6 T.H. Tetenberg, *Environmental and Natural Resource Economics*, 2nd ed. (Boston: Scott Foresman, 1988), p. 364.

effects of inhalation, and third from the ecological effects of fumigations by sulphur dioxide and sulphates. This concern has led to regulations in the United States and Canada that at last deal with total emissions, and not just with ground-level concentrations.

This chapter outlines the major sources of sulphur dioxide in Ontario and the opportunities for pollution reduction. It then explores briefly how the benefits of pollution abatement vary with the location of the source and the extent of the pollution. It presents the current Ontario regulatory framework, and contrasts this with regulations for other air pollutants in Ontario, and with air-pollution regulations in the United States. Economic deficiencies in the existing regulations are then identified. A proposal to convert the existing regulations to marketable rights is presented, and the advantages and disadvantages of that amendment are evaluated. For contrast, I consider an alternative approach — an effluent charge — and compare its likely performance with current regulations and with marketable rights.

Sulphur Dioxide Emissions in Ontario

A few pollution sources account for most of the sulphur dioxide discharged in Ontario. As Table 1 shows, the four largest installations — counting each Ontario Hydro generating station as an installation — discharged 71 percent of total man-made emissions in 1983. The four largest corporate sources discharged over 83 percent of total man-made emissions in that year. The fifth corporate source, an oil refinery, discharged 2 percent, and no other source discharged more than 1 percent. All motor vehicles together discharged about 1.2 percent, with other transportation sources — principally marine vessels — accounting for 1.5 percent, and fuel combustion for heating accounting for another 1.5 percent. The regulation of these emissions is simplified by the ability to control most emissions while dealing with a relatively small number of sources. On the other hand, if one wanted to control all sources, literally millions of polluters would be involved, including all homes

Table 1

Sulphur Dioxide Emissions in Ontario by Source, 1983

(thousands of metric tonnes per year)

Source	Annual Emissions	
Industrial Sources		
INCO	459	
Ontario Hydro	438	
Nanticoke		199
Lambton		171
Lakeview		57
Thunder Bay		9
Algoma Ore	82	
Falconbridge	79	
Subtotal of 4 corporate sources	*1,058*	
Imperial Oil, Sarnia	23	
Shell Canada, Corunna	12	
Other refineries	24	
Algoma Steel	7	
Other iron and steel	14	
Pulp and paper industry	31	
Chemical industry	5	
Miscellaneous industry	48	
Total industrial sources	*1,223*	
Area Sources		
Motor vehicles	15	
Other transport (mostly marine)	19	
Fuel combustion (heating)	19	
Other	1	
Total area sources	*55*	
Total all sources	*1,278*	

Note: Columns may not add up to totals due to rounding.

Source: Ontario, Ministry of the Environment, Air Resources Branch, *Inventoried Air Pollution Emissions of Sulphur Dioxide, Nitrogen Oxides and Volatile Organic Compounds for the Province of Ontario, 1980–1983*, Report No. ARB-187-86-AQM ((Toronto, 1986), Figure 1, Tables 2 and 3.

with oil heating, all industrial boilers that burn oil, and virtually every transportation vehicle.

Abatement of sulphur dioxide emissions is technologically feasible for virtually all sources, but the cost and the technology that would be required differ widely. In the case of the metal smelters belonging to INCO and Falconbridge, pollution control involves rejecting high-sulphur ores, removing sulphur from the ores before they are treated, modifying the treatment process to capture sulphur or sulphur dioxide, or removing the sulphur dioxide from the stack gas before it is discharged. While the basic scientific knowledge is available for a variety of control options, research and development is required to apply even proven technology to existing smelter facilities, and to adapt it to the particular ore composition that each smelter encounters.

Since 1970, both firms have reduced their annual emissions by 65 percent or more (see Table 2). Further reductions are feasible at both firms, but they may involve substantial capital and operating expenditures. Some abatement is achieved by converting sulphur dioxide into sulphuric acid, but the conversion of all of Sudbury's sulphur into acid would greatly increase the North American supply of this acid, depressing its price. INCO predicted that the total capital cost for complying with Ontario's 1985 Countdown Acid Rain program[7] would approach $500 million, but the mill rationalization program was predicted to earn a normal rate of return, while the smelter-abatement plan would earn a 5.9 percent rate of return, so that the net cost is probably under $300 million.[8] Falconbridge anticipated that it could comply with the Countdown program's requirements for a capital cost of $38 million.[9] It appears that increasing abatement can be achieved at increasing cost, and that

7 Ontario, Ministry of the Environment, *Countdown Acid Rain* (Toronto, 1985).

8 Ontario, Ministry of the Environment, *Government Summary and Analysis of the Sixth and Final Planning Phase Progress Reports Submitted by Ontario's Three Major Emitters of Sulphur Dioxide in the Metallurgical Sector* (Toronto, June 1989), p. 10.

9 Ibid., p. 21.

Table 2

Sulphur Dioxide Emissions from Major Ontario Sources, 1970–89

(thousands of metric tonnes per year)

	INCO	Ontario Hydro	Falconbridge
1890–99 (average)	38		
1900–09 (average)	118		
1910–19 (average)	434		
1920–29 (average)	490		
1970	1,991	333	339
1971	1,868	392	362
1972	1,519	343	323
1973	1,186	292	274
1974	1,216	297	258
1975	1,198	311	195
1976	1,191	369	191
1977	1,137	414	200
1978	567	436	117
1979	408	436	88
1980	812	396	123
1981	723	418	114
1982	328	450	61
1983	459	438	79
1984	683	444	84
1985	695	337	74
1986	635	270	90
1987	659	332	72
1988	658	321	60
1989	637	305	68

Sources: Emissions for 1889–1929 are author's estimates based on data presented by the Royal Ontario Nickel Commission, *Report* (Toronto, March 19, 1917, by Order-in-Council 77/79), p. 488, for all nickel smelters operating in the Sudbury area, including INCO and its predecessor, Canadian Copper Company. It is assumed that every tonne of ore roasted contains 25 percent sulphur and yields 0.42 tonnes of sulphur dioxide. Data through 1985 are from D.N. Dewees, "The Effect of Environmental Regulation: Mercury and Sulphur Dioxide," in Martin L. Friedland, ed., *Securing Compliance: Seven Case Studies* (Toronto: University of Toronto Press, 1990), Tables 5, 6, 7. Later data are from Ontario, Ministry of the Environment.

time to perform research and development is of considerable assistance in achieving significant abatement at reasonable cost. These smelters are in competition with producers elsewhere in the world, which imposes some limits on the extent to which they can pass on cost increases.

Ontario Hydro is reducing its acid gas emissions by a combination of strategies, the most important of which is its decreasing reliance on coal-fired power plants by increasing the use of nuclear power and by encouraging energy conservation by consumers. A second strategy is to use low-sulphur coal, and to wash it to remove sulphur (and ash). Ontario Hydro is also installing stack gas scrubbers on some generating units to remove sulphur dioxide from the exhaust gas before it is released. Unlike the smelters, however, Ontario Hydro's emissions grew with increasing electrical demand during the 1970s and, as Table 2 shows, abatement measures had only reduced emissions by the late 1980s to the levels of the early 1970s. High levels of abatement may be achieved by combinations of these strategies, but the costs are high as well. Ontario Hydro estimates that compliance with the Countdown program will cost almost $2.5 billion in current dollars by the turn of the century, and that the marginal cost of abatement in the mid-1990s will generally fall between $500 and $2,000 per tonne of sulphur dioxide controlled.[10] This is consistent with U.S. estimates of costs between US$650 and US$1,500 per tonne at high levels of sulphur dioxide control.[11] Since Ontario Hydro has a provincial monopoly on electricity distribution, it can pass on substantial cost increases with less reduction in demand than could firms in many other industries.

The fourth major source is Algoma Steel's iron ore sintering plant in Wawa, Ontario. Emissions from this plant have fallen since 1970, but as a result of declining production; no pollution controls

10 Ontario Hydro, *Options Available to Meet Acid Gas Limits and Selection of Preferred Options* (Toronto, January 31, 1989), pp. 3, 20.

11 See, for example, B. Elman, B. Braine, and R. Stuebi, "Acid Rain Emission Allowances and Future Capacity Growth in the Electric Utility Industry," *Journal of the Air and Waste Management Association* 40 (1990).

have been installed. It is feasible to remove sulphur from the ore before the sintering process, but this is said to be uneconomic. Indeed, the firm's plan is to meet regulatory limits by limiting production, and there is even some question whether the operation will long survive.[12]

The Shape of Environmental Damage

The common public perception of the relationship between the concentration of pollution in the environment and the harm that pollution causes is that there must be a "safe threshold", below which there is no harm, and above which there is some substantial harm, perhaps increasing as the pollution level increases. Where this concept applies, there are benefits to reducing pollution down to the threshold, but no benefits from further reduction. An often valid alternative is the "linear" model, in which harm begins with the first increment in pollution concentration, and a specified increase in pollution causes the same increase in harm, regardless of the ambient pollution level. With the linear model, the benefits from a given additional quantity of pollution abatement are equal at all levels of pollution (see panel A in Figure 1). If the threshold model applies, it may be best to dictate emissions rates that do not allow the threshold to be exceeded if the costs are not too great. If the linear model applies, then the policy goal should not be to achieve a particular ambient pollution concentration, but to identify a control strategy in which the marginal cost of further abatement is approximately equal to the marginal benefit.

Choosing the correct model is important for properly evaluating alternative pollution control policies. With respect to sulphur dioxide, one must look separately at three types of harm it causes: lake and soil acidification by acid precipitation, injury to human health, and materials damage.

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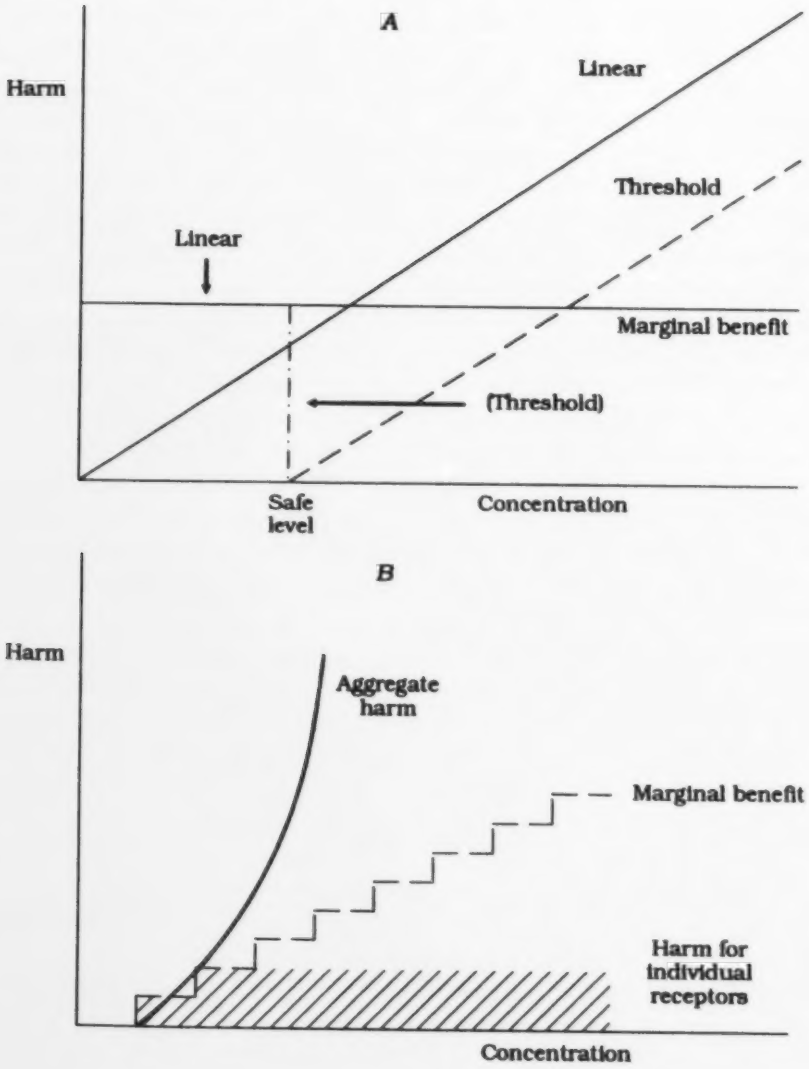
12 Letter from Peter Nixon, President of Algoma Steel, to the Hon. J. Bradley, Ontario Ministry of the Environment, Toronto, July 4, 1986.

Figure 1

Environmental Harm as a Function of Pollution Concentration



In the case of the acidification of lakes and soils, there is generally some natural buffering capability that can offset small amounts of acid rain, but with large amounts this natural buffering may be overwhelmed.[13] For any given lake or plot of land, it may be correct to think about a safe threshold, with harm increasing above that threshold in proportion to the quantity of pollution. A large pollution source will affect many different lakes and soil types, which, in general, will have different "safe thresholds". The total damage function will then exhibit a threshold at the level of the most sensitive lake or soil, and above that level, increasing pollution will increase damage in some environments and cross the safe threshold for others. This creates a damage function that has a very low threshold and increases more than in proportion to emissions (see panel B in Figure 1). Ontario's Ministry of the Environment (MOE) states that the 20 kilograms per hectare per year target adopted by the Countdown Acid Rain abatement goals is "designed to protect all but the most sensitive aquatic systems," indicating that the "no-effect" threshold is still lower.[14]

With respect to human health, the same argument applies. While it is believed that low concentrations of sulphur oxides may not be harmful, some individuals are more vulnerable than others, so the "safe threshold" for the most sensitive person will be the overall threshold, and may represent quite a small concentration. A recent MOE study concludes that the health effects of sulphur dioxide are linear in concentration.[15] For materials damage, clearly some materials are more susceptible than others, and again it is unlikely that the concentration at which *no* damage occurs is very high.

These arguments lead me to believe that, for considerable variations from current emissions rates, the benefits of abatement

13 Ontario, Ministry of the Environment, *Countdown Acid Rain*, p. 3.

14 Ibid., p. 10.

15 Ontario, Ministry of the Environment, *Estimated Public Benefits of Implementing the Proposed Revisions to Regulation 308, Volume III — Appendices D to I* (Toronto: Ministry of the Environment, Policy and Planning Branch, 1990), p. H-7.

are at least proportional to the emissions reduction, and that if there is a concentration below which further benefits vanish, it will not be reached until Ontario's emissions rates are far below current rates.

The harm caused by rain of a given acidity will clearly vary from one region to another, depending on the varying buffering ability of the environment. Similarly, the effects on human health and on materials damage will vary, principally with population density. Because most of the sulphur dioxide is discharged by major sources from relatively tall stacks, it is transported a considerable distance and, with the wind varying in strength and direction throughout the year, the pollution from any one source affects a large and heterogeneous area. This makes it difficult to differentiate the harm caused by one kilogram of sulphur dioxide discharged by, say, INCO and a kilogram discharged from one of the other major provincial sources. The Countdown program assumes that the pollution from various Ontario Hydro generating stations is interchangeable and so is the pollution from all provincial sources, since the emissions rate for each source was derived from a target total emissions rate from the province, not from an estimate of the harm caused by each source. Given what is known and unknown about the harm caused, I believe that it is reasonable to treat Ontario's sulphur dioxide emissions as roughly interchangeable.

Current Regulations

Schedule 1 of Regulation 308 under the Ontario *Environmental Protection Act* prohibits a source from contributing to an ambient concentration of sulphur dioxide that exceeds 830 micrograms per cubic metre of air, unless allowed to do so by a specific regulation — a limitation that has existed since the 1970s. Proposed changes to Regulation 308 will reduce this limit by two-thirds. I am not aware that any of the four major corporate sources has ever been charged with violating this general limit. The important government limitations on emissions from these sources have arisen from control orders and regulations directed specifically at each source. A series

of such regulations preceded the regulations introduced in 1985 in the Countdown program.

In 1970, MOE ordered INCO to construct a 381-meter-high "superstack" in Sudbury to reduce local concentrations of pollution. The ministry then tackled the problem of reducing total emissions, issuing a series of control orders — summarized in Table 3 — that limit the maximum emissions on any working day. While the 1976 limit was met three years early, the 1978 limit could not be met on time and was cancelled in 1978. While the pace of abatement was slow, by 1983 allowable emissions were reduced by more than 60 percent from those allowed in 1972. During the 1970s, before any control orders affected it, Ontario Hydro began to reduce its sulphur dioxide emissions, reducing the sulphur content in its coal. A 1981 regulation set limits for 1986 and 1989 that were increased in a 1982 amendment, and then reduced by the Countdown program. Falconbridge was first subject to a control order issued in 1969, which set a limit for 1975 that was twice postponed because the control methods installed were not effective. Despite the postponement, actual annual emissions fell steadily from the early 1970s until the mid-1980s. Algoma was issued a control order in 1971 — subsequently amended in 1973 — that limited emissions to 285,000 tonnes per year. Emissions fell through the 1970s, not because of controls, but because of declining output.

In 1985, as mentioned above, MOE introduced its Countdown Acid Rain program, a comprehensive set of regulations for reducing acid gas emissions (sulphur dioxide and nitrogen oxides). A separate regulation was issued for each of the four major corporate sources, differing in emissions rates and timing, but similar in general approach. Each regulation applies to a specific corporation, and specifies the maximum annual emissions of sulphur dioxide allowed to all provincial sources belonging to the corporation effective in 1986 and 1994. In the case of Ontario Hydro, an intermediate emissions rate was set for 1990, and a limit was set on the total emissions of sulphur dioxide and nitric oxide. These regulations do not address peak concentrations or local concentrations of sulphur dioxide, but

Table 3

Ontario's Regulatory Limits on Emissions of Sulphur Dioxide

(thousands of metric tonnes per year, unless noted)

	INCO	Ontario Hydro	Falconbridge	Algoma
1970	superstack required			
1972	4,717 t/d			
1974	3,992 t/d			285
1975			422 t/d (postponed)	
1976	3,266 t/d			
1978	680 t/d (cancelled)			
1979			422 t/d (postponed)	
1980	2,268 t/d			
1983	1,769 t/d		422 t/d	
1986	685	370	(154)	180
1990	(525 study)	240		
1994	265	175	100	125
Unspecified	(175 study)			

Note: The relevant regulations are: O.Reg. 660/85 (INCO); O.Reg. 661/85 (Falconbridge); O.Reg. 662/85 (Ontario Hydro); and O.Reg. 663/85 (Algoma). One tonne per day (t/d) effectively imposes a limit of less than 365 tonnes per year, since a given source will not operate at capacity on some, perhaps many, days of the year.

Source: D.N. Dewees, "The Effect of Environmental Regulation: Mercury and Sulphur Dioxide," in Martin L. Friedland, ed., *Securing Compliance: Seven Case Studies* (Toronto: University of Toronto Press, 1990), pp. 376–380.

limit the cumulative emissions from each source instead. They suggest that Ontario has abandoned the early concern about local pollution concentration and the philosophy behind the order that led to the construction of the Sudbury superstack: "the solution to pollution is dilution." Instead, the regulations focus on long-distance transport of sulphur dioxide and on the long-term accumulation of harm arising from its discharge. At the same time, Ontario adopted a new boiler regulation prohibiting new or modified boilers from burning oil containing more than 1 percent sulphur.

These regulations are unusual in that each applies to a corporation instead of to a physical facility, and each specifies a maximum

annual emissions limit. Traditionally, air-pollution regulations have specified maximum concentrations of pollution in the stack gas; or have related allowable emissions to the underlying process activity, such as allowing a specified mass of sulphur dioxide per heat unit of coal burned; or have simply prohibited contributing to a high ambient concentration of the pollutant near the source.

Sulphur dioxide regulation in the United States is quite different from that in Canada. The U.S. Environmental Protection Agency has established ambient air-quality standards for sulphur dioxide, specifying maximum allowable airborne concentrations. The states are responsible for preparing their own implementation plans to achieve these air-quality concentrations. In addition, all *new* U.S. sources must meet the relevant New Source Performance Standards, which limit emissions. In areas that meet the ambient concentration, all new sources must adopt the Best Available Control Technology, while in areas that are not in compliance with the ambient concentration, all new sources must meet the even stricter Lowest Achievable Emissions Rate.

Thus, U.S. regulations treat new sources much more strictly than old sources. This has had the effect of discouraging the construction of new sources and extending the life of old sources, which, in essence, have been given a right to pollute. In the case of sulphur dioxide, the New Source Performance Standards have required all new coal-fired power plants to install equipment capable of removing most sulphur dioxide from stack gasses, whether the coal they burn is high or low in sulphur content — one of the most costly and wasteful regulations that Congress has devised.[16] The *Clean Air Act* amendments of 1990 will include provisions for reducing sulphur dioxide emissions by about 50 percent by the turn of the century, finally imposing limits on old plants as well as new. These regulations will permit sources to trade their allowable emissions with other sources within the region. This appears to satisfy many of the

16 See Ackerman and Hassler, *Clean Coal, Dirty Air.*

demands of economists, who, for years, have argued for the greater use of market mechanisms in pollution control.[17]

In the United States, it is a novelty to treat an entire plant as a single source — as is done in Ontario's Countdown regulations — rather than regulating each point of emissions separately. Indeed, it is so novel that it has been given a special name: a "bubble", as if the plant were placed in a bubble and only total emissions from the bubble counted. I am not aware of any U.S. regulation that groups all sources from a single corporation under a single emissions limit. Furthermore, the U.S. rules originally prohibited the construction of new sources in areas where the ambient air-quality criteria had not been met. This limitation on the possibility of "new jobs" was politically unacceptable, so the Environmental Protection Agency began to allow new sources to be constructed if an existing source would reduce its emissions by more than the emissions of the new source. Thus began the "offsets" program and the trading of pollution rights. Most of this trading has occurred within a firm. Since Ontario's rules are not so rigid, there has been no need to develop marketable rights here.

Finally, Ontario's regulations deal in quantities, specifying limits in tonnes per year, while most of the U.S. regulations specify limits in rates, such as pounds of pollution per ton of product output, or in the case of power plants, pounds of sulphur dioxide per million BTUs of fuel burned. This causes trading to be much easier under Ontario's regulations than under the U.S. regulations. On the other hand, Ontario's approach is more rigid, since the firm cannot necessarily increase emissions if demand increases.

A Critique of Ontario's Countdown Acid Rain Regulations

The regulations contained in Ontario's existing Countdown Acid Rain program have several desirable features when compared with

17 See, for example, T.H. Tietenberg, *Emissions Trading: An Exercise in Reforming Public Policy* (Baltimore: Johns Hopkins Press, 1985).

regulations in other North American jurisdictions. They embody the idea of a plant bubble — indeed, a bubble that is specific to particular corporations — which is a major advance over typical U.S. regulations. They specify total emissions per year, rather than a rate per unit of economic activity, which provides greater predictability regarding total emissions. Finally, they recognize that, with respect to acid gas pollutants, the primary concern is total emissions for the year rather than emissions on any one day, so the limits are specified on an annual basis.

From an economic point of view, however, the Countdown Acid Rain regulations are deficient in a significant way. They do not ensure that the marginal costs of control are equal at all sources, so they do not minimize the cost of achieving pollution control in the province. Compliance with the Countdown program will cost firms in Ontario close to $3 billion during the 1990s. When regulation requires such large expenditures, the government has a duty to ensure that the costs are no greater than necessary to do the job. That duty may not be achieved by the existing regulations. It is entirely possible, and indeed likely, that in any year, or in all years, one of the regulated sources could achieve further emissions reductions at a cost considerably less than some other source. Requiring high-cost control when low-cost control is available is a waste of money and resources.

Tradable emissions rights would solve this problem. An amendment to the regulations that would allow any regulated source to purchase pollution rights from another source in any year when they were not needed would allow the source with high control costs to emit more, by paying another source to emit less. If, for example, INCO can reduce emissions for $100 per tonne, when the same reduction costs $1,000 per tonne at Ontario Hydro, then $900 is saved for every additional tonne of pollution control shifted to INCO from Ontario Hydro. If emissions rights may legally be bought and sold in any year, then the controls will be pursued most vigorously where they are most economical. All this is achieved without increasing the emissions allowed under the Countdown program. Tradable

emissions rights have achieved considerable cost savings in the United States.[18]

There is also the problem of enforcement. Without vigorous enforcement, the Countdown program consists of mere words written on pieces of paper. Perhaps with goodwill, hard work, and massive expenditures, the regulated sources will manage to comply with all aspects of these regulations at all times between now and 1994. On the other hand, perhaps they will not. The history of pollution control in this province and across North America is a history of regulations written and violated, of deadlines missed and rescheduled, of postponement and delay and exception. One cannot study this history and feel perfectly confident that the 50 percent reduction will be achieved by 1994, although by 1990 progress has been most encouraging.

What will MOE do if reports from one or more sources are pessimistic about technology or economics? What if they request delays or increased emissions rates? What if they identify great uncertainties regarding the effectiveness of the proposed control technology? Will the regulations be amended? Will MOE threaten to prosecute firms the first time that allowable emissions are exceeded, if it is perfectly clear that as of that date further reductions are impossible because of long lead times? Like any environmental regulator, MOE is to a substantial extent at the mercy of the expertise and knowledge of the industry that it regulates.

Then there is the problem of prosecuting firms that fail ultimately to comply with environmental regulations. Prosecution takes time, and penalties are subject to considerable judicial discretion. Even the large penalties that are now available may not be applied by the courts, and if they are, they may not induce the use of very costly pollution controls. There is also the "due diligence" defense: a polluter that has taken all possible steps to control its emissions cannot be convicted for violating a regulation.

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18 See R.W. Hahn, "Economic Prescriptions for Environmental Problems: How the Patient Followed the Doctor's Orders," *Journal of Economic Perspectives* 3 (1989): 95–114.

A happier but still troubling problem may arise even when firms can comply completely with the regulations. Suppose that one firm discovers that it is possible to reduce its emissions well below the regulatory limit at a cost little more than that of just meeting the limit. Under the Countdown program, as under any conventional regulatory scheme, there is no incentive to pursue the additional reduction. Indeed, there is every incentive to conceal the ability to achieve this reduction, since an informed ministry might amend the regulation to require it.

What is needed is a means to ensure that it is costly to fail to meet the regulations. What is needed is a means to convince each of the regulated sources that it would be cheaper to pursue pollution control than to postpone, delay, debate, and fail to comply. What is needed is an economic incentive to achieve all economical abatement — to get on with the job of cleaning up acid rain. This will be discussed further below.

Finally, what is the acid rain program after 1994? Will we have reached the optimum and require no further abatement, regardless of cost? Or are marginal benefits still substantial and costs not excessive? If the latter, we will need a new round of negotiations and a new set of regulations. There is nothing in the Countdown program to indicate how this problem will be handled.

A Proposal for Marketable Rights

The problem of minimizing cost could be solved very effectively by implementing a program of marketable pollution rights, applying some of the principles of programs that have operated in the United States, but differing in important details. The design of the program would depend on whether total emissions limit is to be constant after 1994, or whether it will decline.

Suppose first that MOE would be satisfied with maintaining the 1994 Countdown emissions limits at least until the turn of the century. In that case, marketability may be achieved by declaring that any of the major regulated sources may trade their allowable

emissions for a year with any other regulated source. The emissions limit for a source in any year would then be its allocation under its regulation, plus any allocation purchased from another source for that year, less any allocation sold to another source for that year. MOE must be informed of any such purchases, but it would have no right to reject a purchase that conformed to these rules. Purchases could cover one or more years, up to the turn of the century. Implementing this rule would require only minor amendments to the four regulations.

Environmentalists may object to an emissions trading program if it might increase emissions over the amount expected under the present Countdown program. For example, if a source — say, Algoma — were to sell its unused "emissions rights" to another source that then proceeds to use them, this would increase actual emissions in that year. The charge that trading harms the environment could be avoided by reassessing the probable emissions of the four sources and by reducing the Countdown limits to eliminate obvious slack, effective when trading begins, as part of the trading package.

Not many trades would be expected among the four major sources, but even a single trade might save tens of millions of dollars per year, so small numbers of trades are not an indication of failure. Under the U.S. system, most trades have been bilateral, so trading would be similar in Ontario despite the small number of sources. Indeed, there are several reasons why trading of sulphur dioxide rights in Ontario should operate more smoothly than trading programs in the United States. First, there would be no need for regulatory approval of every trade — a major barrier in the United States — given the difficulty of predicting what will be approved.[19] Second, the search for a trading partner would be trivial, while in the United States it is often difficult. Third, there is little reason to expect environmentalists to resist individual trades if they have agreed to such trades in principle, because the baseline for trading

19 R.W. Hahn and G.L. Hester, "Where Did All the Markets Go? An Analysis of EPA's Emissions Trading Program," *Yale Journal on Regulation* 6 (1989): 109–153.

is clearly set forth in the Countdown regulations; in the United States, there is a concern about inflated baselines. Finally, a clear statement about the longevity of the rights, lasting until the end of the century, should allay fears that engaging in trades will compromise future bargaining with MOE about emissions regulations.

This proposal is simple compared with the marketable pollution permit proposals in the 1990 amendments to the U.S. *Clean Air Act*. The reason is that the Countdown regulations are already expressed in terms of tonnes of emissions per year, so they are clearly defined in units that can be traded. In the United States, most trading has involved emissions reduction credits, which are based on allowable emissions rates defined per unit of input or output. There is much room for debate over how much the firm *could have emitted*, and therefore how much credit it has to trade. The U.S. trading programs were added to regulations that were badly suited to the market mechanism, while Ontario's Countdown regulations are, luckily, perfectly adapted for trading.

There remains the problem of all the other sources. While the four major sources accounted for 80 percent of emissions in 1983, by 1994 they will have reduced their emissions by about 50 percent, so the "small" sources should account for closer to 40 percent of the remaining emissions, no longer an amount that could be ignored. A straightforward solution to this problem would be to write additional regulations establishing emissions limits for the largest of these sources, and to allow them to participate in trading. In the case of refineries and other industrial sources releasing sulphur dioxide from processes, as opposed to fuel burning, some control technology is likely to be available at some cost.

The major problem that will arise as smaller sources are incorporated in the regulations will be the increasing relative cost of estimating their emissions to determine compliance with any regulatory scheme — at some point it will not be worthwhile to add smaller sources. Small oil-burning boilers, for example, can reduce emissions only by burning lower-sulphur oil or by switching to natural gas. In this case, a ban on burning fuel oil with more than a given

sulphur content might be the most appropriate solution, extending the current new boiler limit of 1 percent sulphur in the oil to all boilers. Home heating oil rarely contains more than 1 percent sulphur in any event, and it is not clear that further reducing its sulphur content is worthwhile. Finally, transportation sources are so numerous, and their emissions so individually small, that they are probably not worth regulating, except for extending the fuel-sulphur-content regulation to marine vessels.

Suppose, however, that MOE anticipates further emissions reductions between 1994 and the turn of the century. In this case, it should first identify its goals and amend the Countdown regulations to incorporate the desired emissions reductions for later years. As 1994 approaches, MOE will have more information than it did in 1985, when the Countdown program was established, and may find that reduced emission limits better meet its objectives. Once the full set of limitations is in place, then a trading system can be instituted as described above, using as the baseline for trading in any year each source's emissions limit for that year.

Finally, suppose that once a trading system is in place, MOE decides that further overall reductions are needed below those incorporated in existing regulations. It would be constrained in its actions, since it will have declared existing emissions limits to be property rights that will not be confiscated. Rewriting the regulations to reduce allowable emissions *within the period covered in the existing regulation and the trading system* would violate the assumptions on which the trading had taken place. Presumably, these rights could be taken by compensating the rights holders. With only four sources and few trades taking place, it is unlikely that a stable market price will have been established at which these rights could be expropriated, and sources might behave strategically in demanding payments far above their marginal costs in exchange for relinquishing some rights. No simple solution suggests itself, but the principle on which a solution could be built is this: Before establishing marketable rights, MOE should decide what right, if any, it has to confiscate part of those rights over what time period, and how compensation is

to be determined; that aspect of the rights should be clear to all parties before the system is set in place. In short, the regulatory system would become a contract between MOE and the polluters, under which changes could be made only in accordance with clearly identified rules. This would not be terribly different from the present situation, in which MOE faces indignant resistance if it revises downward a regulatory limit shortly after firms have made investments to comply with that limit.

The Alternative of Emissions Charges

The small size of this market renders trading thin, so few trades will occur and a single stable price is unlikely to emerge. This means that two objectives of the plan, to equate marginal costs of abatement among all sources and to learn the marginal cost of abatement, will be achieved only imperfectly. Furthermore, with this thin market, the small sources that may be included in an expanded regulatory scheme may not be well treated if they wish to buy rights from the large sources. A would-be new source that wanted to locate in Ontario might discover that no existing source was willing to sell at a particular point in time. Because of these difficulties, the use of effluent charge alternatives may be an alternative means to achieve the goals of the rights scheme.

One scheme would set the Countdown limits as the maximum emissions rates for regulated firms. MOE would estimate an average marginal cost of abatement per tonne of sulphur dioxide controlled — call this MC — based on the information submitted by the regulated sources under the Countdown program. Beginning after 1994, sources would be allowed to discharge at the regulated rate, but a charge would be levied for fully using the allowed emissions, at the rate of MC per tonne, applied perhaps to the last 2 percent of the allowed emissions. Each year, the emissions that would be subject to the charge would increase at a specified rate, perhaps 2 percentage points per year. Thus, in 1994, all allowed emissions would be free; in 1995, the last 2 percent would attract the charge,

in 1996 the last 4 percent would attract the charge, and so forth. Sources could not exceed the regulatory limit, and would be under pressure to decrease their emissions every year, although there would be no compulsion to do so. New sources would join the program whenever MOE set regulatory limits for them.

Since the Countdown limits would remain, there is no environmental risk; emissions may not be greater than allowed in the regulations. There would be the benefit that sources whose abatement costs fell below MC would reduce their emissions over time. However, the charge, combined with the current Countdown program, would fail to achieve the considerable benefit of allowing low-cost sources to sell emissions rights to high-cost sources and thereby reduce the overall cost of abatement.

A comprehensive solution to these problems would combine the trading of emissions rights with the effluent-charge proposal. Sources would be allowed to trade emissions rights as proposed in the preceding section. Any source would be allowed to emit the amount defined by the rights held by that source, whether acquired directly from MOE or purchased from other sources. Over time, the emissions that could be discharged without penalty per unit of rights held would depreciate, so that all sources would find themselves paying a charge for an increasing percentage of their allowable emissions.

Finally, the enforcement problem could be addressed by an automatic penalty for emissions exceeding the rights held. This penalty may be completely independent of any criminal prosecutions for violation of the standard. It would only be necessary to add to the existing regulation a statement that any discharge in excess of the amount allowed by the regulation would require that the source pay to MOE an amount equal to the excess emissions times a specified price. The price should be set at a level such that it would be less expensive to install controls than to discharge excess emissions, perhaps equal to 1.5 times MC. This automatic charge for exceeding the regulation would provide a powerful economic incentive to comply with the regulation. Thus, the firm that experienced a surge

in demand for its product would not have to leave that demand unsatisfied if it implied excess emissions, but would have to pay dearly for those emissions. This should not be an undue financial burden on a firm experiencing excess demand, but it would provide a strong incentive to install controls that would bring emissions within the limits as soon as possible. There is precedent for this approach in sewer surcharges applied in Canada, in the automatic penalties under the corporate average fuel economy program in the United States, and in some provisions of the acid rain section of the 1990 amendments to the U.S. *Clean Air Act*.

Conclusions

There has been no trading of emissions rights in Canada, despite a considerable amount of such activity in the United States, because Canadian regulatory schemes have not involved the rigidities that gave rise to trading in the United States. Ontario's Countdown regulations, which treat entire firms as a single pollution source, are examples of regulations that are much more flexible than typical U.S. regulations, and indeed embody a corporate bubble, which would be regarded in the United States as a major regulatory innovation.

Still, it appears that the marginal costs of controlling sulphur dioxide may vary greatly among the four major corporate sources in Ontario, so that total costs of control may be tens of millions of dollars per year higher than necessary. Allowing these sources to trade their emissions rights in any year has the potential for considerable savings in pollution-control costs while still achieving the environmental goals specified in the current regulations. Relatively simple amendments to the existing regulations could achieve these savings. While trades would be few, few are required to achieve substantial gains.

A major barrier to trading in the United States has been the uncertain definition of the rights being traded. To make such a system work in Ontario, or elsewhere in Canada, it is essential that the regulatory agency determine in advance what emissions are

allowable, over a considerable period of time, and by what process it may change these limits. Once this has been done, emissions rights have been defined, and it is a small step to allow them to be traded among sources.

Finally, the additional problems of enforcing the regulations and reducing emissions after 1994 could be attacked by adding an emissions charge to the tradable rights. At any time, emissions in excess of those allowed by emissions rights would attract an automatic financial penalty that is proportional to the emissions excess and sufficiently large to encourage compliance. In addition, after 1994 an increasing percentage of the emissions allowed by the rights would require payment of an emissions charge, although at a smaller rate than excess emissions. This charge would induce firms to reduce their emissions over time in response to a predictable economic incentive, while allowing the flexibility to emit more if desired, subject to paying the charge.

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7 Water Pollution and the Canadian Pulp and Paper Industry

Norman C. Bonsor

This chapter examines alternative approaches for dealing with the problem of water pollution from Canadian pulp and paper mills. The pulp and paper industry was the first major industrial sector in Canada to be subject to widespread regulations aimed at reducing the flow of pollutants into receiving waters. There are now almost 20 years of experience on which to draw to assess how the particular regulatory approach adopted in this industry has functioned. The experience of different regulatory approaches that have been applied in other major pulp and paper producing countries — in particular, Finland, Sweden, and the United States — can also be instructive.

Few countries have attempted to substitute or supplement the regulatory command approach with market-based incentives. This chapter suggests that, at least in some circumstances, a market-based approach can yield more efficient solutions than can a total reliance on regulations specifying the amount of pollutants that can be deposited in the environment.

Existing Canadian regulations are in the process of being altered at both the federal and provincial levels. The federal government has announced proposed new regulations that will come into force by the beginning of 1994, and many provinces are also adopting new regulations. It is therefore appropriate to consider whether or not

these proposed changes are likely to be an improvement over the existing regulatory approach.

An Overview of the Problem

Water pollution is produced in two ways: by the direct discharge of effluent into receiving waters — for example, from municipal sewage treatment facilities and from industrial and agricultural activities — and by the deposition of air-borne particles. Two broad types of pollutants are responsible for water quality problems in Canada:

- "traditional" biodegradable organic waste, which has a very short-term impact on water quality; and
- chemical substances that are mainly the by-products of manufacturing operations and that are highly persistent in — and often highly toxic to — the environment.

Although the "traditional" pollutants do biodegrade fairly rapidly, the process exerts an oxygen demand on receiving waters, measured by what is known as the "biochemical oxygen demand" (BOD), which reduces the amount of dissolved oxygen in the water and thus reduces its ability to sustain aquatic life.

The pulp and paper industry is Canada's largest industrial discharger of water-borne pollutants. On a daily basis, the industry consumes 1.8 billion gallons of fresh water — equal to 38 percent of the total volume of water used in the Canadian manufacturing sector — and discharges 2,000 tonnes of BOD, which represents approximately 80 percent of the total industrial discharge of BOD. The pulp and paper industry's daily BOD discharge is roughly equivalent to that which is placed on receiving waters by the discharge of untreated domestic sewage from a population of 14 million persons.[1]

In the case of pulp mills that use chlorine in the bleaching process, organochlorines — including dioxins and furans, which are

1 This estimate is based on the BOD loads at a number of Ontario municipal sewage-treatment facilities.

highly toxic and persistent in the environment — are discharged into the environment along with "conventional" pollutants.

In contrast to air pollution, most water pollution is localized. In the case of effluent from the pulp and paper industry, the pollution problems are also for the most part highly localized. In terms of conventional pollutants, the impact of BOD on a receiving water's dissolved oxygen is, with rare exceptions, limited to an area within a few kilometers from the point of discharge. Total suspended solids (TSS) typically settle in an area very close to the point of discharge.[2] Organochlorines, on the other hand, affect a significantly larger area than do conventional pollutants.[3]

In 1988, the pulp and paper industry accounted for roughly 3 percent of Canada's gross national product, and ranked first in the manufacturing sector in terms of value added and total wages paid.[4] It produces approximately 30 percent of the world's newsprint and 15 percent of the pulp, and is heavily reliant on export markets — in 1988, 76.4 percent of total industry shipments were exported, with U.S. markets accounting for over 50 percent of total Canadian production.

Most of the 151 mills that the industry operates are located in small communities. One study estimates that 90 percent of the industry's total capacity is located in communities of less than 100,000 persons and 50 percent in communities of less than 10,000 persons.[5] For many locations in the Atlantic provinces, Quebec, Northern Ontario, and British Columbia, the industry represents the

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2 In the pulp and paper case, these are wood fibers that are discharged into the receiving water. These solids form a mat on the bottom of the river or lake and create an oxygen demand as they biodegrade over time.

3 A. Grimvall et al. *Organohalogens of Natural and Industrial Origin in Large Recipients of Bleach Plant Effluent*, Proceedings of the 3rd IAWPRC Symposium on Forest Industry Wastewaters, Tampere, Finland, June 5–8, 1990.

4 Canadian Pulp and Paper Association, *Reference Tables 1989* (Montreal: Canadian Pulp and Paper Association, 1990).

5 K.E. de Silva, *The Pulp and Paper Modernization Programme: An Assessment* (Ottawa: Economic Council of Canada, 1988).

major source of income and employment. Most of these communities would face a very bleak future if the local mill were to close down. Governments and the industry itself are fully aware of this and, as is argued later in the chapter, this has been one of the reasons for the slow pace of effluent reductions in the industry.

Regulatory Options for Performance and Standards Setting

The basic cause of the water-pollution problem as it relates to the pulp and paper industry is that property rights usually are not defined. Where they are, in fact, defined, they lack enforcement. In the Canadian case, property rights to water resources reside with the federal and provincial governments. In the past, firms have enjoyed the *de facto* right of free disposal of industrial effluent into receiving waters. Spurred by public demand for a reduction in the flow of pollutants, governments have begun in recent years to enforce their property rights to water resources by passing an increasing number of laws and regulations that — at least on the surface — limit the ability of industry to discharge pollutants.

It is important to differentiate between the two major types of pollutants: conventional pollutants, such as BOD and TSS, and "priority" or highly toxic pollutants. Conventional pollutants have, as noted above, a relatively short-term effect on the environment. An effluent's biochemical oxygen demand is merely an estimate of the potential damage that the effluent has on the aquatic ecosystem. Whether or not that potential is realized depends on a number of factors such as the dilution available to the effluent in the receiving water, the extent of other BOD discharges, water temperatures, and the re-oxygenation coefficient in rivers. (Many of the highly publicized fish-kills attributable to pulp and paper mill pollution occur in summer months, when water temperatures are high and river flow is low — conditions that reduce oxygen levels and the ability of the water to assimilate BOD discharges). For example, a large volume of effluent with a high BOD load could have a minimal impact on

dissolved oxygen levels and thus on the environment if the receiving water is very large and dilution is rapid. On the other hand, a small volume of effluent with a lower BOD load could easily produce water conditions lethal to fish if the receiving water is small or if dilution is slow.

The problem of BOD does not seem to be irreversible. There are numerous examples showing that receiving waters rendered unsuitable for fish habitat by high effluent loadings from pulp and paper mills have recovered fairly quickly once the effluent flow has been greatly reduced.[6]

Considerable concern has been expressed in recent years over the problem of highly toxic and persistent chemical substances in industrial effluent. In the pulp and paper industry, this concern has centered on organochlorines. Every day, a single large bleached-kraft mill may discharge 10 or more tonnes of chlorinated organic effluent containing large numbers of unidentified substances.

Many organochlorines are formed in the kraft-bleaching process whenever chlorine or chlorine-based compounds are used. Thousands of chlorinated organic compounds exist, but only a small proportion of those in kraft-mill effluent have been identified. Many of the identified organochlorines in kraft-mill effluent, although acutely lethal to fish, are only moderately persistent in the environment, with half-lives measured in weeks. The real cause for concern in kraft-mill effluent is the presence of very small amounts of potentially dangerous chlorinated dioxins and furans, and the high probability that it contains other, undiscovered and highly toxic

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6 A classic study of the Spanish River, in Northern Ontario, reported that a small bleached-kraft mill producing 200 tonnes of product per day had a BOD loading of at least 75 kg per tonne of product, equal to a BOD loading per day of 15 tonnes. In 1986, the mill produced 885 tonnes of product a day and discharged only 2.2 tonnes of BOD a day — an 85 percent reduction in load and a 30-fold reduction in effluent per tonne. The river is now fishable. See J.R. Dymond and A.V. Delaporte, *Pollution of the Spanish River*, Technical Series Research Report 25 (Toronto: Ministry of Lands and Forests, 1952).

substances.[7] Seven B.C. coastal fisheries are currently closed due to contamination by chlorinated dioxins and furans in the effluent from kraft mills. Minute amounts have also been found in some products made from bleached-kraft pulp, such as milk cartons and coffee filters.

Options for Dealing with Priority Pollutants

In the case of "priority" pollutants — which, as noted above, are those that are potentially highly toxic — the appropriate regulatory strategies are probably limited to setting performance standards to restrict the emissions of such substances. The rationale for strict performance standards rests in part on the potential danger to society and the potential irreversibility of the effects of these substances on the environment — or at the very least, their potential for long-term damage.

Even in such cases, however, it should be noted that market forces can exert considerable pressures on producers. Many Canadian producers of bleached-kraft pulp, for example, are being asked by customers to eliminate the presence of dioxins and furans in the product. Supermarkets in many Canadian cities have recently begun to market paper products that are unbleached or made from "oxygen-bleached", rather than chlorine-bleached, pulp. Since mid-1988, when the dioxin "problem" was the subject of considerable media attention, emissions from Canadian mills have been drastically reduced, even though dioxins are not, as yet, regulated substances.[8] In this particular case, market forces appear to have functioned more quickly than the regulatory approach.

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7 N.C. Bonsor, N. McCubbin, and J.B. Sprague, *Kraft Mill Effluent in Ontario* (Toronto: Ministry of the Environment, 1988).

8 N. McCubbin and N.C. Bonsor, "Economic Impact of Proposed Regulation of Pulp and Paper Industry BOD, TSM and Toxicity, Organochlorines (AOX) and Dioxins and Furans" (Background Document submitted to the Department of the Environment, Ottawa, 1990).

Performance standards for priority water pollutants typically have been set in accordance with a technological standard. Allowable emissions are determined on the basis of what existing engineering techniques can deliver in terms of minimizing or eliminating the discharge of the pollutants. An example of this approach in the case of priority pollutants is the notion of the "best available technology economically achievable" (BATEA) — a phrase that first appeared in Section 301 of the U.S. *Clean Water Act*. It is, of course difficult to determine what this phrase actually means, even though it is gaining wide acceptance in the formulation of pollution regulations in Canada. BATEA, for example, is one of the cornerstones of the high-profile Ontario Municipal-Industrial Strategy for Abatement.

What U.S. legislators and the regulators at the U.S. Environmental Protection Agency (EPA) had in mind was to determine the cost of a number of candidate technologies for achieving varying levels of performance standards — that is, effluent emissions standards — and to assess the economic and financial effects on producers of adopting these technologies. While it is relatively easy to specify and cost the available technologies,[9] it is not possible to specify which ones are economically achievable, since this notion cannot be defined with precision. In practice, the EPA has judged whether a given effluent standard is economically achievable by the number of plant closures and job losses that the regulation would entail. A technology or performance standard that is anticipated to lead to 10 percent or more of all plants in an industry to close would not be judged economically achievable.[10]

A regulatory approach based on setting limits according to technological criteria has a number of inherent problems. First, if technology changes over time, producers may be faced with consid-

9 See, for example, Bonsor, McCubbin, and Sprague, *Kraft Mill Effluent in Ontario*.

10 For a detailed discussion of the many flaws in the indicators used by regulatory agencies to determine the likely impact on an industry of adopting given performance standards, see J.B. Sprague, N. McCubbin, and N.C. Bonsor, *Non-Kraft Mill Effluent in Ontario* (Toronto: Ministry of the Environment, forthcoming).

erable expense for adopting new methods if regulatory bodies alter performance standards. Second, as Benoit Laplante argues in Chapter 3, the industry may lack the incentive to invest in research aimed at developing better control technology that would permit improved performance levels.

Options for Dealing with Conventional Pollutants

In the case of conventional water pollutants, the choice of strategies is considerably broader than that for the priority pollutants. Regulators can, for example, specify technology-based limits. In the case of pulp and paper mills, it is very easy to determine performance standards based on known technology for each subsector of the industry for both new entrants and existing producers. In 1982, the EPA set such standards for BOD and TSS emissions by the U.S. pulp and paper industry according to what is known as the "best practical control technology currently achievable" (BPT). BPT-based standards place fewer restrictions on effluent flows than do standards based on BATEA.[11]

The major problem with technology-based limits is that, even in a static sense, they are inherently flawed as a mechanism for securing optimal results. Reliance on technology-based limits leads to a "one-size fits all" situation that is likely to result in some receiving waters being underprotected and others overprotected. Regulatory limits based on technology are almost always specified in terms of the permissible level of pollutants per tonne of product produced. For example, EPA currently allows bleached-kraft mills to emit 5.5 kg

11 Intermediate between BATEA and BPT are standards based on "best conventional pollutant control technology" (BCT). The EPA attempted to set performance standards for the pulp and paper industry equal to BCT, but the U.S. Federal Court required it to establish a two-part economic test in order to judge the "reasonableness" of the proposed limits. Since none of the candidate technologies could meet this rather bizarre test, BCT levels were set equal to BPT limits.

of BOD per tonne of product, implying that a large mill producing 1,000 tonnes of pulp per day would be permitted to discharge 5.5 tonnes of BOD per day, whereas a mill producing 500 tonnes of pulp per day would be permitted a daily discharge of 2.25 tonnes of BOD. The impact on the environment of a tonne of BOD per day varies, depending on the assimilative capacity of the receiving water, the number of other dischargers, and so on. In the case of receiving waters with a large capacity to absorb BOD flows, little in the way of environmental improvement will be accomplished by "tight" regulatory limits. Where the capacity of the receiving water is small or where rapid dilution is not available, the "one-size fits all" rule will not adequately protect the environment. Examples of both situations are easily found for Canadian pulp mill discharges.

In Canada, most water-pollution regulations have specified "end-of-pipe" performance standards. In the pulp and paper sector over the past two decades, this has meant using standards based on the production of BOD and TSS, with the additional requirement that the effluent not be acutely lethal to fish, both measured at the point of discharge — hence, end-of-pipe. The BOD and TSS limits were based on what can loosely be described as good industrial practice at the time the regulations were introduced in 1971. Yet, after almost 20 years, only a minority of mills have an effluent that actually meets performance standards.

One of the many problems with performance standards is that the regulations may be counterproductive. For example, the existing test of acute lethality consists of placing rainbow trout in a 65 percent concentration of mill effluent for four days. If more than 20 percent of the trout die, the effluent is judged to be acutely lethal to fish.[12] In reality, a mill that produces a large amount of a weak effluent may be able to pass the acute-lethality test simply because the effluent has a low concentration, whereas a mill that produces less effluent

12 Canada, Department of the Environment, Environmental Protection Service, *Pulp and Paper Effluent Regulations: Regulations, Codes and Protocols Report* (Ottawa, 1971/72).

in total but in a more concentrated form may fail the test. A regulation based solely on concentration of matter in discharge streams thus may lead mills to discharge more pollutants in total than one based on the total volumes of materials. With this in mind, a number of researchers have recommended that a toxicity emissions rate be used, a measure that takes into account the volume of pollution per tonne of product.[13]

Optimal Regulatory Approaches Based on Biological Considerations

Biologists and environmental scientists have as an end goal the protection of natural communities of organisms. The ideal and ultimate goal is for a zero discharge of effluent, since this would represent the maximum degree of protection. Any feasible regulation limiting the discharge of industrial effluent is thus a compromise between zero and what is possible at a given point in time.

One recent study proposes three tactical approaches for the design of regulatory performance standards to limit the discharge of water pollutants:

- end-of-pipe limits based on "good current technology" for amounts of pollutants emitted;
- limits based on water-quality objectives to prevent sublethal effects on aquatic communities; and
- periodic biological surveys to check whether the first two tactics provide the intended degree of protection.[14]

In terms of the end-of-pipe limits set under the first of these tactics, these are seen, in the case of conventional pollutants, to be a "course

13 See J.B. Sprague, "Environmentally Desirable Approaches for Regulating Effluent from Pulp and Paper Mills" (Paper presented at the 3rd IAWPRC Symposium on Forest Industry Wastewaters, Tampere, Finland, June 5–8, 1990, Mimeographed).

14 Ibid.

screen" sufficient to prevent "obvious abuse." Persistent or toxic pollutants would be subject to more stringent limits.

Regulatory Approaches Based on Economic Considerations

From the viewpoint of maximizing benefits from expenditures on water-pollution-abatement procedures, regulations limiting the discharge of conventional pollutants should be based in part on the characteristics of the receiving waters. There may be little point in forcing a specific mill to spend a large sum of money on reducing the flow of conventional pollutants if the impact on the receiving water is minimal, as may be the case if the water body is large and rapid dilution is available.

From the viewpoint of the economist, an optimal level of pollution abatement occurs — at least in theory — where the marginal cost to society of reducing a unit of pollution is equal to the benefits to society of the reduction in pollution. Conceptually, the benefits to society are equal to the underlying value that individuals place on the improvement in water quality. While it is relatively simple to estimate the cost of pollution abatement, it is very difficult to determine an adequate measure of the marginal benefits to society. Improvements in water quality give rise to five different types of economic benefits:

- reduced human health risks from less-polluted water supplies;
- benefits to commercial fishing;
- improvements to water-based recreation;
- enhanced non-use values; and
- ecological benefits.

In two of these cases, however, the economic benefits are difficult to measure. There is absolutely no evidence to suggest that reduced effluent flows from pulp and paper mills will have any effect on human health risks. Moreover, it is not currently possible to place a monetary value on ecological benefits, and at least a part of society's

demand for ecological improvements will be captured in estimations of non-use benefits.

The three benefits to which one can attach a dollar value arise from the very simple fact that reductions in BOD and TSS will lead to localized water-quality improvements that will permit the receiving water to be used more widely or more intensively. For example, improvements in dissolved oxygen levels may permit a larger fishery or for the fishery to be upgraded from rough fishing to game fishing, which brings larger economic benefits.

Improvements in water quality that are captured by users of the water-based resource — commercial and sports fishing, for example — are known as "user" or "direct" benefits. "Non-use" or "indirect" benefits arise when individuals receive economic benefits from water-quality improvements they may never use for consumptive purposes (fishing, swimming) or nonconsumptive purposes (bird watching, for example). At the heart of the notion of non-use values is belief that individuals are willing to pay for water-quality improvements that they do not intend to consume directly. Non-use values are thought to arise for three reasons:

- *bequest values*: the value that society puts on passing on to future generations an improved or maintained environment;
- *option values*: the "insurance value" of preserving the option to use the resource in the future; and
- *preservation values*: the value society places on "knowing" water quality has been improved.

The problems involved in attempting to measure the economic value of water-quality improvements are complex, and a detailed discussion of them is beyond the scope of this chapter.[15] The basic

15 For excellent discussions of these problems, see D. Brookshire and V. Smith, "Measuring Recreational Benefits: Conceptual and Empirical Issues," *Water Resources Research* 23 (1987); and W.H. Desvougea, V. Smith, and A. Fisher, "Option Price Estimates for Water Quality Improvements: A Contingent Valuation Study for the Monongahela River," *Journal of Environmental Economics and Management* 14 (1987).

root of the problems is that, for the most part, receiving waters are open-access resources, meaning that a price is not levied on users and thus there is no ready information on demand functions or on the consumer's willingness to pay. Economists attempt to measure the benefits either by survey methods or by estimating the value of improvements indirectly from the prices of a set of private goods and services — that is, ones for which market prices exist.

Although the value of environmental benefits is thus somewhat controversial, a large number of studies have placed values on the benefits to be derived from water-quality improvements at specific sites. Given such detailed, site-specific information on the probable impact of regulations on the quality of the receiving water and associated changes in fish populations, it is at least possible to provide upper and lower bounds on the probable value of economic benefits that will serve as important reference points in the design of performance standards.

We can easily identify a number of key variables that are major determinants of the user benefits flowing from water-quality improvements. The nature of fish populations will vary from site to site and, since some fish species are more valuable than others, so will the level of economic benefits. Game fish — salmon and trout, for example — will command larger values for both sports and commercial fishing than will rough fishing — carp and pike. Estimates in the literature vary from a high for sports fishing of $110 a day for "world-class" salmon fishing on the Campbell river in British Columbia to $7 a day for rough fishing in Ontario.[16] The accessability and location of a site are also important — a site that is easy to get to will be of greater benefit than a similar site with more limited access, while a site that is close to large population centers will also be more

16 See DPA Group Inc., *Economic Valuation of the B.C. Tidal Sports Fishery* (Vancouver: Canada, Department of Fisheries and Oceans, 1985); Marshall Macklin Monaghan Ltd., *Assessment of Proposed Remedial Action Plans for Hamilton Harbour* (Toronto: Ministry of the Environment, 1988); and A. Bruno and P. Blyth, "Valuation of Water Quality Improvements," in *Proceedings of the 1989 Technology Transfer Conference* (Toronto: Ministry of the Environment, 1989).

valuable. As well, sites for which close substitutes are available will tend to have greater benefits attached to them than similar sites which lack substitutes.

The general conclusion here is that, in order to maximize the net economic benefits to society — estimated benefits less estimated costs — regulations limiting the emission of conventional pollutants should be site specific, rather than of a type that imposes industry-wide blanket performance standards. Receiving waters with high use and non-use values would be accorded, given the available degree of dilution, a higher level of protection than receiving waters with lower use and non-use values.

Canadian Regulatory Policy and Instruments

Since the 1960s, federal and provincial policies on the discharge of water pollutants have tended to use focused, "end-of-pipe" treatment standards. Regulations limiting the discharge of specific substances — BOD and other specified contaminants — have been formulated for a wide range of industries in most provinces. These regulations typically define an upper limit to the amount of pollutants that can be discharged per unit of production.

Widespread and detailed regulations limiting the discharge of harmful substances to Canadian receiving waters are relatively recent. At the federal level, the major legislative initiative has been the *Fisheries Act*. The 1960 amendments to the act made it an offence to discharge unauthorized substances that are harmful to fish. Authority under the act to set standards for the discharge of industrial effluent did not come about until 1971.

The first regulations under the amended act were directed at limiting the discharge of BOD and TSS from pulp and paper mills. The major reason for starting with this industry was simply that it accounted for a very high — and frequently highly visible — proportion of total Canadian water pollution. In many cases, BOD and TSS emissions from mills had seriously degraded the quality of receiving

waters and severely reduced or even eliminated fish populations. The new regulations were formulated after extensive discussion with the pulp and paper industry, and the end-of-pipe treatment standards were based on what a reasonable producer could achieve by using in-plant pollution controls. No consideration was given to basing effluent quality on what could be achieved if secondary (biological) treatment facilities were installed, even though such treatment facilities had been widely used elsewhere to reduce the level of BOD discharges.[17] The limits on BOD and TSS were to be applied only to new and expanded mills — that is, mills constructed after November 1971, and mills that subsequently expanded their production by at least 10 percent or that altered their production process for reasons other than pollution reduction.[18] In fact, the regulations on BOD and TSS discharges under the act have had only a very narrow application: in 1990, only 10 percent of all pulp and paper mills are subject to these regulations.

Section 33 of the *Fisheries Act* contains a general prohibition on the discharge of any effluent that is harmful to fish — the acute-lethality test noted above. Compliance with this regulation has been less than outstanding: in 1981, a decade after the regulation was introduced, only 36 pulp and paper mills were able to pass the test.[19] By 1987, the situation was substantially the same, with only 37 mills producing an effluent that was not acutely lethal to fish.

Protection of receiving waters is shared between the federal and provincial governments. At the federal level, the administration of the environmental policy aspects of the *Fisheries Act* is the responsibility of the Environmental Protection Service of the Department of the Environment, rather than the Department of Fisheries and

17 See W. Sinclair, *Controlling Pollution from Canadian Pulp and Paper Manufacturers: A Federal Perspective* (Ottawa: Department of the Environment, 1988).

18 In fact, only the expanded portion of the mill is subject to the regulations.

19 Canada, Department of the Environment, Environmental Protection Service, *Status Report on Abatement of Water Pollution from the Canadian Pulp and Paper Industry* (Ottawa, 1984).

Oceans. The federal government is broadly responsible for all seacoast fisheries, while the provincial governments are responsible for inland fisheries.[20] Both levels of government have negotiated administrative arrangements for the enforcement of Section 33 of the *Fisheries Act*. Most provinces have enacted regulations for control of water pollution from pulp and paper mills that are similar, though not identical, to those contained in the federal act.

Federal and provincial government prosecutions of pulp and paper mills under Section 33 have been relatively rare despite wide-spread violations — a case in point being the majority of mills that still fail the acute-lethality test — and fines have been insufficient to serve as a deterrent.[21] The usual approach has been that as long as a mill complies with provincial requirements, the federal government will not normally intercede even if those requirements fail to meet the spirit or intent of the *Fisheries Act*.[22] Mills in Ontario, in particular, seem to be immune from federal prosecution, though mills in other provinces — including several in British Columbia — have been prosecuted.

In a *de facto* sense, then, the major responsibility for controlling water pollution, especially in the case of the pulp and paper industry, rests with the provincial governments. The tool they use most often is the negotiated control order, whereby the regulatory authorities negotiate with an individual firm a control order that defines permissible effluent loadings and compliance schedules. In many cases, the provinces specify not only end-of-pipe limits but also the technology to be used by the mill in achieving the limits. One of the results of this approach is that effluent-quality standards vary dramatically from mill to mill. In 1990, for example, some mills in Ontario were

20 In reality, the situation is more complicated than this, with the division of responsibility being specific to different species of fish.

21 See P. Nemetz, "Federal Environmental Regulation in Canada," *Natural Resources Journal* (1986): 551–608.

22 F.J. Anderson, *Natural Resources in Canada*, 2nd ed. (Toronto: Nelson, forthcoming).

among the cleanest in the world, while others had very high discharge rates.[23]

Regulatory authorities face a serious problem in implementing environmental policy through mill-specific control orders, since producers trying to meet demands for improvements in effluent quality recognize that they have significant bargaining power. Compliance costs for meeting nontrivial regulatory limits can be high for existing producers. Typically, capital expenditures will be required and unit production costs will increase, especially if secondary treatment facilities are required. It is entirely rational for firms to attempt to persuade the regulatory authorities that the required water-quality improvements are not required or that compliance costs are so large that the firm's economic viability would be threatened. Frequently, firms couple this argument with the threat that if they are not granted a variance in the control order, they will be forced to close down. Individual producers also claim that effluent standards are lower — and, thus, so are compliance costs — for competitors located in the same and other jurisdictions. In many instances, such threats have resulted in negotiated compliance orders that have led to little improvement in effluent quality.

Regulatory authorities rarely have detailed knowledge of actual compliance costs, and rely heavily on cost estimates provided by the firms themselves. With few exceptions, regulators have been far more concerned with the impact of policy changes on the economic viability of the producers than with the overall economic impact of the changes on society as a whole. This is not surprising, since, as noted above, compliance costs are more easily determined than the associated benefits. Benefits are typically diffuse and dispersed across a large subset of the general population, and have the appearance of not being highly tangible. Firms that are subject to

23 Based on 1987 data, the average discharge of BOD for mills in Ontario was 20.1 kg per tonne. One large mill had a discharge of only 2.0 kg per tonne, while another mill — essentially similar in terms of product and size — had a BOD discharge of 20.7 kg per tonne. For Canada as a whole, BOD discharge rates ranged between fewer than 2.0 kg per tonne to a high of 236 kg per tonne. See McCubbin and Bonsor, "Economic Impact."

the regulations and that will bare much of the compliance costs have a large incentive to keep regulatory authorities firmly focused on the cost aspects.

Canadian policies toward reducing water pollution by the pulp and paper industry have not been very successful, nor would one expect them to have been, given the manner in which the regulations have been designed.[24] One study notes that "the problems encountered by those responsible for administering the enforcement of the regulations are substantial. There are jurisdictional ambiguities, definitional uncertainties, legal difficulties, technical limitations, and discretional dilemmas."[25] Another study succinctly notes, in connection with the reluctance of regulators to invoke penalties for noncompliance, that there is an "implementation gap".[26]

I am not suggesting that, had the environmental policy formulated in the *Fisheries Act* been implemented, the resulting level of environmental protection would have been optimal. Existing and proposed federal and provincial government policies aimed at improving water quality are inherently flawed — this is also true, to a lesser extent, of U.S. policies. Almost no attention has been paid to the underlying relationship between regulatory limits on effluent discharges, environmental-quality improvements, and the value of such improvements to society.

Regulatory Approaches in Other Countries

As stressed earlier, the Canadian pulp and paper industry is heavily reliant on export markets, the most important being the United States. Canadian producers frequently have objected to proposals for tightened effluent-quality regulations on the grounds that the

24 Major reductions in BOD and TSS discharges have occurred since 1970, but not all mills have shown the same rate of improvement.

25 Sinclair, *Controlling Pollution from Canadian Pulp and Paper Manufacturers*.

26 K. Webb, *Industrial Water Pollution Control and the Environmental Protection Service* (Ottawa: Supply and Services Canada, 1988).

cost of meeting such regulations is higher in Canada than elsewhere. The implication, given that the technology and associated compliance costs of water-quality improvements do not vary greatly among the major producing countries, is that the suggested Canadian standards are more onerous than those in place elsewhere.[27]

The United States

In the United States, the EPA has adopted three main regulatory tactics for controlling water pollution from pulp and paper mills:[28]

- end-of-pipe limits on BOD, TSS, and priority pollutants, and acute-lethality tests not just on fish but also on plants, invertebrates, water fleas, and algae;
- site-specific water-quality criteria, including a sublethal test on three species; and
- biological or chemical surveys of receiving waters.

The EPA specifies technology-based standards for the discharge of conventional pollutants and some nonconventional pollutants. These limits represent minimum mandatory standards: individual states may enforce tighter requirements, while the EPA may — and, in fact, does — specify lower standards in certain circumstances.

In 1982, the EPA specified limits for 33 subcategories of the U.S. pulp and paper industry. Technically, the individual limits were based on the application of the best practical control technology currently available for conventional pollutants, and tighter limits for priority pollutants based on the application of best available technology. Thus, for conventional pollutants, the limits represent what the application of the commonly available, relatively low-cost technology of the mid- to late 1970s could achieve.

27 Bonsor, McCubbin, and Sprague, *Kraft Mill Effluent in Ontario*.

28 These are very similar in spirit to those suggested by Sprague, "Environmentally Desirable Approaches for Regulating Effluent from Pulp and Paper Mills."

Almost all U.S. mills were in compliance with these regulations by the end of 1984, and no mill seems to have shut down because of high compliance costs.

U.S. regulatory limits on traditional mill effluent are significantly more stringent than the existing Canadian federal limits on BOD and more stringent than even the proposed Canadian standards for 1994, as Table 1 indicates.[29] Moreover, the tougher U.S. regulations appear to have worked. One study of discharges by kraft mills in the two countries reveals an average BOD discharge in the United States of 3.68 kg per tonne of output compared with approximately 17 kg per tonne in Ontario — and at that, the average rate of BOD discharge in Ontario is below that for Canada as a whole.[30] At the same time, however, testing for acute lethality did not become part of the U.S. regulatory package until at least the mid-1980s — when it became a requirement for the issue of renewed discharge permits — and the United States still has no federal regulations limiting the discharge of organochlorines from bleached-kraft mills, although individual states have begun to introduce such limits.

Scandinavia

In Finland and Sweden, policies during the 1970–85 period toward water pollution by pulp and paper mills concentrated successfully on reducing discharges of BOD — by 55–65 percent in Finland and by 60–70 percent in Sweden.[31] BOD loadings have continued to decline in both countries since 1985, with the reported average BOD

29 It should be noted, however, that the majority of U.S. mills discharge effluent into rivers that may be less able, on average, to dilute pollutants than are rivers available to Canadian mills; accordingly, tougher emissions standards may be justified in the United States.

30 TSS discharges were essentially comparable in both jurisdictions. See Bonsor, McCubbin, and Sprague, *Kraft Mill Effluent in Ontario*.

31 Committee for the Gulf of Bothnia, *The Water Pollution Problem of the Pulp and Paper Industries in Finland and Sweden* (Helsinki, 1987).

Table 1

Regulatory Limits on Biological Oxygen Demand (BOD) and Total Suspended Solids (TSS) Discharged by Pulp and Paper Mills in Canada and the United States

(Kg per tonne of product produced)

	United States		Canada	
Type of Mill	**BOD**	**TSS**	**BOD**	**TSS**
Market-bleached kraft	5.5	9.5	7.5	11.25
			for all categories	
Unbleached kraft				
Linerboard	1.8	3.0		
Bag	2.7	4.8		
Semichemical	1.6	3.0		
Groundwood-fine paper	1.9	3.0		
Groundwood-CMN	2.5	3.8		

discharge in Sweden being about 11.5 kg per tonne of product in 1988.[32]

In the mid-1980s, Swedish authorities became concerned about the effects of discharges of organochlorines, particularly into the Baltic Sea. In 1987, the Swedish government accepted the recommendations of the National Swedish Environmental Protection Board to place limits on such discharges from bleached-kraft mills. The short-term objective written into discharge permits is for the release of organochlorines to be reduced to below 2 kg per tonne of product by 1992–93. The long-term policy calls for the "virtual elimination" of such discharges. A unit tax of the consumption of chlorine is also being considered. Although few Swedish discharge permits place limits on BOD, the technology that will be required to meet the organochlorine limits also will lead to significant reductions in BOD.

32 A. Melin, "The Swedish Perspective on Regulation of Pulp Mill Effluent" (Paper presented at the 4th Colloquium on Pulp and Paper Mill Effluent, Toronto, September 19–20, 1989).

In Finland, most pulp and paper mills discharge into rivers and lakes that have limited dilution ability. As a result, Finnish authorities have focused on the reduction of BOD discharges, which are to decline by 65 percent from their 1986 levels by 1995, by which time they may approach those currently in place in the United States. Finland has also recently introduced a policy to limit the discharge of organochlorines from pulp mills to 1.4 kg per tonne of product by 1995.

The Proposed Canadian Regulations

In April 1990, the Department of the Environment released draft proposals for new regulations under the *Fisheries Act* concerning the discharge of pollutants from Canadian pulp and paper mills.[33] The new regulations will apply to all mills — thus doing away with the present distinction between new, altered and modified, and old mills — and will feature stricter limits on the discharge of conventional pollutants compared with those introduced in 1971.[34] BOD discharges will be reduced to a monthly average of 7.5 kg per tonne, and TSS discharges to a monthly average of 11.25 kg per tonne. Mills will have until January 1, 1994, to comply. The acute-lethality test will continue to be used, not just on rainbow trout but on daphnia magna — a type of water flea — as well.

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33 This section is based on McCubbin and Bonsor, "Economic Impact."

34 It is highly probable that new mills will face far more stringent limitations on emissions of both conventional and nonconventional pollutants than existing mills. In addition to provincial requirements, the federal Environmental Assessment Review Process is being used to look at the potential impact of new pulp and paper mills on the environment. In 1989, the federal government intervened in the Alberta hearings on the environmental impact of the proposed ALPAC mill in northern Alberta. Even though the mill would have had an effluent discharge lower than any other mill in the world, ALPAC was not granted permission to construct it. ALPAC is in the process of submitting a revised plan. In September 1990, the federal government ordered a review of five other pulp and paper projects in Western Canada, including one in Saskatchewan that is under construction and scheduled to begin production in February 1991.

The draft regulations are, of course, complex. They also contain a number of exceptions, one of which is that any non-sulphite mill that reduces its BOD by 85 percent but still cannot meeting the 7.5 kg per tonne limit may be authorized to discharge up to 15 kg per tonne. This exception may be only of minor importance, however, and will probably apply only to a very small number of mills. Mills using a sulphite process, which is inherently more polluting than other processes,will be allowed a TSS discharge rate of 38 kg per tonne and a BOD discharge level set according to a complicated method that appears to imply a maximum discharge of around 40–50 kg per tonne.

Regulations have also been proposed under the *Canadian Environmental Protection Act* to limit the discharge of dioxins and furans to a nondetectable level, given existing measuring protocols, from mills using chlorine in the bleaching process. A companion regulation would ban the use of defoamers and woodchips that have been contaminated with chemical compounds that could react with chlorine to form dioxins and furans.

As of August 1990, the Department of the Environment had not released draft regulations on limits for organochlorines. Kraft mill operators are lobbying hard for a limit of 2.5 kg per tonne, whereas environmental groups are pushing for a limit of no greater than 1.5 kg per tonne, a target which is not technically difficult to achieve even in existing mills.[35] In addition to the secondary-treatment devices required by the proposed regulations on conventional pollutants, mills also would be required to install an oxygen-delignification stage and to substitute chlorine dioxide for chlorine to a high degree. The addition of an oxygen stage would, in fact, cause declines

35 Quebec, Ontario, and British Columbia have announced new regulations controlling emissions of organochlorines. For mills in Quebec, the limit is to be set at 1.5 kg per tonne by the end of 1993. Ontario and British Columbia will require all mills to limit output to 2.5 kg per tonne by the end of 1991, with B.C. mills having to meet an even lower 1.5 kg per tonne limit by the end of 1994. Alberta has not placed formal limits on organochlorines, but will require new mills to adopt technology that will effectively reduce such emissions to below 1 kg per tonne.

in variable production costs and lead to decreases in the costs associated with the treatment of conventional pollutants.

Compliance Costs

Of the 145 mills that would be affected by the proposed regulations, 35 are already meeting these higher standards of pollution control. A small number of others are close to doing so, and thus will face only relatively small expenditures on additional effluent treatment facilities.

The capital investment that will be required in order for all mills to comply with the regulations has been estimated at $2.3 billion (1990 dollars). For individual mills, the estimated capital costs range from zero, for those already in compliance, to a high of $75 million, with most mills facing costs in the range of $10–40 million. Clearly, then, those companies that have already spent a considerable amount of money over the past few years in reducing their effluent discharges will now face far lower compliance costs than companies that have spent little or nothing.

In addition to capital expenditures, the pulp and paper industry will face an increase in operating costs of $211 million per year (1990 dollars), most of which is related to the operation of secondary treatment facilities. This figure does not include interest charges or depreciation on the required capital investment. Over a 20-year period, the marginal cost to society of complying with the proposed regulations will be $4.93 billion (1990 dollars), given a real discount rate of 5 percent. At a 10 percent discount rate, the marginal cost will fall to $4.19 billion. Table 2 provides a detailed breakdown of the compliance costs across major industry subcategories.

Among individual mills in each major category, costs are highly proportional to the existing quality of the effluent they produce. Newsprint mills, for example, which account for approximately 30 percent of pulp and paper production in Canada, will face costs ranging from a low of zero (one mill) to a high of $47.72 per tonne of

Table 2

The Canadian Pulp and Paper Industry's Costs of Meeting Proposed Federal Limits on Conventional Pollutants

($ per tonne of product)

Type of Mill	Operating Costs	Capital plus Operating Costs
Newsprint	$1.94	$22.13
Integrated kraft	5.61	11.38
Market kraft	5.15	10.73
Semichemical	17.37	28.79
Mechanical	11.50	26.79
Sulphite	30.90	59.80
Average, all types	*9.55*	*17.49*

Note: For ease of comparison, capital costs have been amortized to a cost-per-tonne basis assuming a required after-tax rate of return of 10.48 percent and the accelerated depreciation allowances accorded investments in pollution-treatment facilities by Class 24 and Class 27 under Canada's corp-orate income tax system. The amortization factor used is equal to 8.19 percent, which represents an upper end to what can be assumed.

output. On average, the required capital compliance costs will equal $32 million per newsprint mill.

Table 3 details compliance costs by region. Average compliance costs range from a high of $27.13 per tonne of product for B.C. coastal mills to a low of $4.68 for mills in the B.C. interior. Estimated compliance costs are considerably above average for mills in the B.C. coastal region and in Quebec, and below average in the other regions.

The reason for these regional differences is largely due to differences in existing regional BOD loadings. Regional compliance costs are highly correlated with regional BOD discharges. BOD discharges are high, and almost identical, in Quebec and the B.C. coastal regions (32.5 kg per tonne in Quebec and 31.3 kg per tonne in the B.C. coastal region) and lowest in the B.C. interior (12.7 kg per tonne). On the B.C. coast, only 3 of 13 mills have any form of secondary treatment facilities and 4 mills lack even primary treatment facilities. In Quebec, only 6 of 48 mills have secondary treat-

Table 3

Costs of Meeting Proposed Federal Limits on Conventional Pollutants, by Region

($ per tonne of finished product)

Region	Cost
B.C. coast	$27.13
Quebec	$21.75
Atlantic provinces	$15.68
Ontario	$13.11
Prairie provinces	$8.97
B.C. interior	$4.68
Canada	*$17.49*

ment facilities. By comparison, all but one of the mills located in the B.C. interior have secondary treatment facilities.

Past and present environmental standards are the main determinant of the likely cost of meeting the proposed new standards, which raises the question of the effect on the industry as a whole. In the short run, the compliance costs represent an upward movement of the industry's average and marginal cost curves. The extent to which the cost increases are borne by producers in the form of a lower rate of return on capital is dependent on the degree to which compliance costs can be passed on to customers in the form of higher market prices or backwards to factors of production other than capital in the form of lower payments. In the important newsprint and bleached-softwood-kraft pulp sectors, Canadian producers have an element of market power, since they account for a significant portion of supply in a number of major markets. Given a relatively inelastic demand for major products and the fact that compliance costs are likely to increase in other major pulp and paper producing countries, it is probable that at least a portion of the regulatory-induced cost increases will be borne by consumers in export markets.

A number of mills face compliance costs that are significantly greater than average for their particular production category, espe-

cially in the case of newsprint. These mills are generally below the size required for a minimum efficient scale of operation and are operating with obsolete equipment, some of which was installed as long ago as the mid-1920s. Many of these old mills would very likely have had to shut down in the near future in any event, or commit significant amounts of capital — in some cases, as much as $250 million — to upgrade plant and equipment. The proposed regulations merely will speed up the decision as to what to do with these mills.

With regard to dioxins and furans, the capital cost of industry compliance with the proposed regulations is estimated to be $567 million, with no impact on operating costs. The average compliance cost per tonne of pulp is equal to $4.48. The process changes that are required in order for mills to comply with regulations on dioxins and furans will also enable mills to limit the discharge of organochlorines to 2.5 kg per tonne.

Alternatives to Direct Regulation

The proposed new regulations limiting the discharge of conventional pollutants by pulp and paper mills are not likely to be an optimal solution. They are not, for example, based on the capacity of the individual receiving waters to absorb BOD flows and are likely to lead to some waters being overprotected and others underprotected. In addition, regulations in existence since 1971 have only been enforced in a very limited manner: the majority of Canadian mills still discharge an effluent that is acutely lethal to fish.

In order to maximize net benefits to society, greater use needs to be made of site-specific water-quality requirements, particular with regard to BOD loading. With this information, it would then be possible to move away from placing technology-based limits on individual polluters, and to concentrate instead on the total loadings placed on a river or lake. An overall quota on the permissible BOD loading could then be set.[36] Each polluter would receive or purchase

36 See J.H. Dale, *Pollution, Property and Prices* (Toronto: University of Toronto Press, 1968).

an initial quota, with quotas being freely tradable. Any one polluter wishing to discharge more than its quota allows would have to purchase a part of the quota from some other producer. The quota system would minimize the costs involved in reducing the amount of pollution to the optimal level. Existing polluters would look at the cost of reducing effluent discharges from the installation of abatement equipment versus trading in permits on the market. If there are sufficient polluters on a given receiving water, a competitive price for a unit of quota would be set at the point where the marginal cost of pollution and the marginal benefit from pollution were equal.

Setting and allowing trades in pollution quotas has a number of distinct advantages over the existing regulatory approach, as well as a number of problems. One major advantage is that, provided that the market price of a unit of the quota is greater than zero and nontrivial, polluters will have an incentive to invest in less-polluting technology. Another advantage is that the method is even handed across industries — at present, the application of the technology-based approach allows some industries to discharge higher loads per unit of production than others. In the case of quotas, industries that find it less costly than others to reduce effluent flows will be sellers of quotas, while industries that have high costs in reducing effluent flows may be buyers. Finally, enforcement may be a lot simpler than under the existing regulatory approach.

The major problem with the implementation of a quota scheme is that, in a large number of cases, the effluent source is a single mill. Thus, the notion that quotas could be bought and sold would not apply, and one of the central requirements of the system would not be present. The single source of effluent would thus need to have a quota set for it on the basis of the capacity of the receiving water, a result that would be identical to that achieved by optimal regulation. Still, in a number of cases, the idea of a quota scheme to replace existing point-source regulations is one that is worthy of greater consideration. It should be noted that pollution quotas may be more widely applicable to air pollution than to water pollution, simply because air pollution is generally less localized.

It is also possible to place unit taxes on the amount discharged by each point source, instead of using the existing regulatory approach. The notion of securing an optimal reduction in the amount of what economists refer to as a "negative externality" that is being produced in an economy has a long tradition in the literature. Polluters faced with a tax per unit of effluent — that is, per unit of BOD — would reduce effluent to the point where the marginal cost of further reducing effluent, measured by the cost of installing and operating abatement equipment, equalled the saving in tax payments. The problem in implementing an optimal tax scheme is that of determining the value of the tax. If the tax per unit of effluent is set equal to the estimated value of the damage that a unit of effluent causes to the environment, then the optimal tax should yield exactly the same solution as would an optimal regulation set according to site-specific criteria.

Incentives

Canadian pulp and paper mills have been the recipients of significant subsidies and other incentives from federal and provincial governments. Most of the subsidies have been directed at expansion and modernization of facilities, rather than at improvements in effluent quality. One minor exception to this was the Pulp and Paper Modernization Programme, a highly controversial federal-provincial shared-cost subsidy program which began in 1979. The program was limited to Ontario, Quebec, and the Atlantic provinces — the western provinces refused to take part. The basic aim of the subsidies, which totalled in excess of $500 million, were to assist individual firms to modernize their production facilities, to conserve energy, and to reduce water and air pollution, although very few of the subsidies were in fact used for pollution-abatement purposes.[37] The program ended in 1984 in Ontario and 1988 in the other provinces except Newfoundland, where it is due to end in 1991.

37 See de Silva, *The Pulp and Paper Modernization Programme*.

There are a number of problems associated with suggestions that pulp and paper mills be subsidized for the cost of complying with tighter effluent standards. First, as noted above, the cost is highly correlated with existing effluent levels. Mills that have already invested heavily in reducing effluent flows face the lowest costs — in a number of cases, zero — in complying with the new standards. To subsidize mills that have not made such investments raises issues not only of equity but of morality: why should such mills be rewarded for failing to spend resources on effluent-treatment facilities?

Another problem is the implications of subsidies for Canada's international trade relations. Producers have frequently suggested that their competitors in other countries — particularly in the United States and Scandinavia — have been heavily subsidized for the costs entailed in reducing effluent flows. This is simply not so.[38] The most important market for Canadian-produced pulp and paper is the United States. On an annual basis, over 50 percent of the Canadian industry's entire output is sold in U.S. markets. Were Canada now to offer its mills significant subsidies for water-pollution-abatement facilities, U.S. producers likely would charge Canada with "unfair" trade practices.

The most significant existing incentive offered to polluters is the federal corporate income tax system's preferential tax treatment of capital expenditures on equipment to control water and air pollution. For sites in operation prior to 1974 — all pulp and paper mills that are required to expend resources to meet the proposed federal regulations fall into this category — pollution-control equipment can be depreciated on an accelerated cost-recovery basis. While the effect of this up-front tax advantage is somewhat limited and varies across firms in accordance with their tax positions, it does reduce the cost of capital investments in abatement facilities compared with investments in production facilities.

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38 For evidence, see Bonsor, McCubbin, and Sprague, *Kraft Mill Effluent in Ontario*.

Conclusions

The existing set of regulations aimed at reducing the flow of water pollution from Canadian pulp and paper mills has not been enforced. Almost 20 years after the passage of the 1971 amendments to the *Fisheries Act*, only a small number of mills have an effluent that is not acutely lethal to fish — a direct violation of the intent of Section 33 of the act.

The foundations on which federal regulatory policy is based — one-size-fits-all, end-of-pipe performance standards — are inherently flawed. The proposed new regulations, which are expected to come into effect by the beginning of 1994 — promise only a more refined version of the 1971 regulations, albeit applicable to all direct and some nondirect discharge mills.

In the case of conventional pollutants, an optimal policy would take account of site-specific water-quality requirements in setting the overall level of pollution loadings. Once this is done, a variety of regulatory or market-based approaches to setting individual discharge levels can be used to attain efficient reductions in effluent emissions.

Although market-based approaches offer a superior alternative to direct regulation of conventional pollutants in a number of cases, there is a reluctance on the part of governments to consider such alternatives seriously. This reluctance is due in part to the general feeling that devices such as quota schemes are nothing more than "licenses to pollute", even though a well-designed scheme would show results superior to those that are likely to occur under the existing regulatory framework.

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8 The Case for Pollution Taxes

Nancy Olewiler

Economists have long advocated taxation to deal with environmental problems. Taxes can correct the distortions in markets that arise because many of the goods and services provided by the government are not priced. The disposal of waste products has been treated as a right freely available to all. The premise of an environmental tax or charge is quite simple. The tax establishes a price for using the environment. The environment must then be treated as a scarce good by producers and consumers.

Taxation has many advantages apparent to economists, although their enthusiasm for taxes is not shared by decisionmakers in government and the private sector. Why? Opposition to taxation is often based on self-interest. Polluters are clearly worse off individually after the imposition of environmental taxes, although society as a whole may be much better off. The same cannot be said about command-and-control legislation. Taxes are generally unpopular with the public, which may view them as another revenue "grab" by governments. The impact of taxation on environmental quality is less certain than that of standards — if they are imposed and enforced. Physical standards establish targets for emissions or ambient environmental quality. These are easy to comprehend compared to the often complex features of taxes. The goal of reaching an efficient level of pollution that is generally positive is not welcomed by those who

want major changes now. The argument that taxes are economically efficient does not convince the public that "something is being done" about pollution, nor does it elect politicians. It is not surprising that opposition to taxation has been both widespread and successful in Canada.

Why, then, rehash the debate about taxes versus other pollution policies? In today's political, economic, and environmental climate, we can no longer depend on the policies that have been used in the past. North America has now had over 20 years of experience with the extensive use of standards under command-and-control legislation. While there have been some improvements in environmental quality over this period, it would be difficult to argue that standards have been a rousing success. There are many serious problems that standards have not addressed. As well, Canadians have paid millions of dollars for pollution policies. Where does this money come from? It comes from taxpayers. Are we getting good value for our tax dollars? The simple answer is no. Command-and-control policies are expensive and must be financed out of general government revenue. In a time of crippling deficits, it is hard to be optimistic that the environment is going to be a major recipient of scarce government funds.

The object of this chapter is to make the case for the inclusion of pollution taxes and charges as one of the instruments in the arsenal for improving environmental quality. No single type of policy instrument is appropriate for all types of environmental problems. Canadian governments act as if command-and-control policies are the policy of first choice.[1] Taxation is rarely examined seriously. Marketable permits or tradable emissions rights have recently become a "fashionable" instrument to consider, but permits are not universally applicable to all environmental problems.

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1 Evidence of this is seen in the federal government's "Green Paper". Taxation is not mentioned. In Ontario, the Municipal/Industrial Strategy for Abatement (MISA) program apparently did not even consider the role of market incentives to deal with major sources of pollution.

To make the case for taxes, this chapter first examines the benefits of taxation. The second part of the chapter considers some of the challenges to taxes and the responses to these criticisms. It concludes with a discussion of when taxes could be used.

Taxes: Why Now?

A series of arguments support the use of taxation to improve environmental quality. As mentioned above, the existing mix of policies being used in Canada has not worked as well or as quickly as many had hoped. It would not be prudent to ignore powerful instruments such as taxation.

Taxes Put a "Price" on Pollution

A tax or charge on the use of the environment as a waste depository forces people to treat pollution as another good. This allows the forces of supply and demand to lead to efficient use of the environment if the tax is set equal to the value of environmental damages resulting from production and consumption activities. Pricing the environment provides incentives for all who use it to change their behavior and to use it more conservatively. This is true for consumers of the goods and services generating pollution as well as for the producers of those goods. It is easy for those concerned about environmental quality to cast blame on the industries responsible for emissions. They forget that as consumers of the goods these industries produce, they too are responsible for deterioration of environmental quality. Under most circumstances, a tax on emissions, outputs, or the inputs in the production process will be passed along to consumers.[2]

2 If the tax is levied on output of goods and services, it will be shifted forward — at least partially — to consumers as long as the producers are not facing a perfectly elastic demand curve for their product — as long as the price of the good produced is not exogenously given or fixed by markets that are unaffected by the tax. If the tax is levied on pollution-generating inputs into the production (or consumption) of goods and services, the tax will be borne by producers and...

The tax makes the environmental cost of our activities apparent. A standard can camouflage the link between consumption activities and pollution. Standards may provide little or no incentive for consumers to alter the environmentally damaging activities. Taxes are thus in the spirit of the "environmental awareness" the pollsters say the public has. Taxes require all of us to pay for our use and abuse of the environment.

Taxes Minimize the Costs of Improving Environmental Quality

This argument involves the use of concepts familiar to economists, but often quite alien to others. Suppose an emissions tax is put on firms depositing a particular type of waste into the atmosphere or waterways. The tax rate is set per unit of the waste product emitted. Any firm facing this tax will have the choice of continuing to discharge just as much waste as it did before the tax, or to reduce its emissions. If the firm does not control any wastes, it will pay the government a tax bill consisting of the tax rate times the total emissions. If the firm reduces its emissions, it will incur costs for however much it abates, plus pay a tax bill on the uncontrolled emissions. The key point is that the firm decides how best to respond to the tax. If the costs of controlling emissions are lower than the tax per unit, the firm will stop discharging. If the costs of control exceed the tax, the firm will continue to pollute. Firms with the lowest costs of controlling emissions will abate the most.

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...consumers as long as demand for that input is not perfectly inelastic — that is, unresponsive to changes in that input's price. It will also be felt by the owners of the inputs as long as they are not supplied perfectly elastically — at only one price unaffected by any taxes. Individuals will change their consumption habits in response to any of these taxes — including those levied at the retail level — as long as their demand for the good or service is not perfectly inelastic. While it is beyond the scope of this paper to examine in detail all the possible inputs and outputs that could be taxed, I would be surprised if many were supplied or demanded under conditions that led to no response in their use.

The direct costs of controlling emissions — exclusive of costs of imposing and enforcing the policy — will be as low as they possibly can. Governments need not dictate to firms how to control their wastes, as is generally done in command-and-control legislation — in the form of requiring specific technologies for abatement be used. If society wants to minimize the costs of meeting some environmental target, the tax is the preferred instrument. It is hard for economists to imagine that people would want to pay more than is necessary to improve environmental quality.

Implications for Technological Change and Innovation

Taxes provide incentives to invest in technologies that control emissions at lower costs than existing techniques or that control more emissions at the same cost. This follows directly from the arguments made above. If a different production process can yield the same output with less pollution, a firm would lower its tax liability by adopting that process. Of course, the cost of the process must be weighed against the tax saving. The process will be purchased if the present value of the tax saving incurred over the life of the technology is at least equal to the cost of the process.

This type of response means that there will be some uncertainty about when and if firms adopt new technologies. There may be an interval over which pollution does not decrease substantially as firms try to determine the cost-minimizing method of reducing their tax liabilities. But the private sector is very clever at finding ways to reduce taxes. It will not continue to pollute for long periods of time, especially if the tax rate is high enough to make the cost of "doing nothing" regarding wastes untenable.

Taxes should also spawn new industries trying to find these pollution-reducing technologies, for they will now have a market for their processes that did not exist before the imposition of the tax. These incentive effects are quite different from the impact of command-and-control policies with their requirements for specific tech-

nologies. Once the required technology is in place, there is no incentive to look for others that may be lower cost or more effective at reducing emissions. Pollution abatement is expensive and, once in place, firms will not be lobbying for alternative approaches to control emissions. For example, suppose an electrical generating station is required to install stack gas scrubbers to reduce emissions of sulfur dioxide. There will be no incentive for the utility to seek cheaper devices or less-polluting inputs — for example, low-sulphur instead of high-sulphur coal — unless the regulations change again.

The incentive to innovate and invest in new technologies also has implications for the competitiveness of industries. Competition in pollution-controlling technologies is encouraged by taxation of emissions. This may not be the case with command-and-control legislation. Take the example of the scrubbers above. Once a technology has been set by regulation,[3] there is little incentive to look for new ones. If the controlled industry contains few firms, there are likely to be few suppliers of the required technology simply because the market is small. It would be more difficult for a competitive pollution-control sector to develop under these circumstances.

Taxes Generate Revenue

A pollution tax or charge corrects the distortions that arise from the failure of markets to price the use of the environment as a waste depository. Unlike most other taxes levied by governments, pollution

3 These technological requirements often have been in the form of "best practicable" or "best available" technologies (BPTs and BATs). The way many command-and-control policies have worked is to examine the industry's ability to control emissions — generally in consultation with the industry. The initial decision regarding technology determines the best one currently available — the BAT. Firms are required to install the BAT within some time frame. Meanwhile, the regulators and industry look for alternative technologies that are better and/or cheaper at controlling emissions, but still feasible — the BPT. A schedule for switching from BATs to BPTs is announced. Once these technologies are set, there is no incentive to seek others unless, of course, the emissions are still deemed to be too high. Then, regulations must be rewritten, an expensive and time-consuming process.

taxes do not create incentives for inefficiency; instead, they correct inefficiencies and improve social welfare. This is an important point that is easily overlooked when opposition to taxes is mounted by special-interest groups. Society as a whole can be better off with the introduction of a pollution tax.[4]

A key question arises: What should be done with the tax revenue obtained from pollution taxes? First, note that the amount of tax revenue collected depends on the tax rate and the ability of those taxed to reduce their emissions. If tax rates stay constant, governments can expect to collect more revenue in the short term when those taxed are more constrained in their response to the tax. Over time, revenue can be expected to fall as the taxed parties seek costs of control that are less than the taxes paid — as discussed above. Indeed, if taxes are doing their job to improve environmental quality, not a lot of revenue would be raised.

All this suggests that governments should not look to pollution taxes as a major revenue source. Some economists (and others) have been advocating environmental taxes to raise revenue and reduce government deficits.[5] Their argument is that the impact on the economy would be twofold. Revenue is raised in a distortion-reducing manner compare to other taxes, and environmental quality is enhanced. As already noted earlier, the revenue raised could be modest and falling over time. If these revenues were used for deficit reduction or in lieu of other taxes, governments would be very tempted to adjust the tax rates so as to maintain a constant (or increasing) flow to their coffers. The taxes would soon become tied to objectives other than efficient levels of pollution. Pollution tax rates should be tied to environmental quality, not other fiscal requirements.

What, then, could be done with the revenue raised? Two suggestions emerge, both of which are strong arguments to "sell" the

4 Obviously, certain groups could be worse off. This topic will be addressed below.

5 See, for example, D. Terkla, "The Efficiency Value of Effluent Tax Revenue," *Journal of Environmental Economics and Management* 11 (1984): 107–123; W. Oates, "Taxing Pollution: An Idea Whose Time Has Come?" *Resources* 91 (Spring 1988); and G.B. Doern, ed., *The Environmental Imperative: Market Approaches to the Greening of Canada*, Policy Study 9 (Toronto: C.D. Howe Institute, 1990).

use of taxes as a policy for the environment. First, tax revenues could be used to improve environmental quality directly. Why not tie these taxes to specific types of expenditures on the environment? This makes the pollution tax a "benefit", or earmarked tax. Improvements in environmental quality come from three main sources: reductions in emissions — or the production and consumption of emissions-intensive goods — cleanups of the existing stock of contaminated ecosystems, and investment in new technologies that lessen the tradeoffs between the environment and economic activities.

Standards, taxes, and marketable permits work on the first of these sources. How do we pay for the second? Some countries have started funds — for example, the Superfund in the United States — to clean up toxic sites. Part of the financing comes from levies on polluting industries, the rest from general revenues.[6] Canada should impose something similar. We have our own toxic sites and a long list of areas needing improvement. Taxes on polluters or pollution-intensive goods could be tied to these cleanups. That way, governments cannot divert these funds to other activities — for example, subsidizing megaprojects such as James Bay and Hibernia, which can lead to adverse environmental impacts. Benefit taxes would also be an important selling point to a public and a corporate sector suspicious of government motives. Politically, it would be difficult to oppose such taxes. Who wants to be on record as opposing the environment? As in the United States, the revenue raised from these taxes may be much too small to deal with major investment in improving the environment, but the revenue would help.

The revenue could also be used to augment private sector investment in environmental research and development (R&D). The case for government support comes if one feels that this sort of R&D would be undersupplied because of the difficulty of keeping technological information proprietary. The extent of the need for these funds is an empirical question that requires more investigation.

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6 Thus far, the levies under the Superfund legislation have been a small percentage of the total cost of cleanup.

The second major way to use pollution tax revenues is for redistributive purposes. Governments could use the money to compensate those made worse off by the imposition of the tax. The need for compensation is likely to be short term. As tax revenues decline, so do losses incurred from the tax. It is well known that pollution taxes may be efficient but not equitable. Polluting firms with immobile capital would suffer capital losses with the imposition of an emission tax. Low-income consumers who cannot shift their consumption bundle in response to taxes on pollution-intensive commodities are other candidates for some compensation.

The key point is that if compensation is contemplated, it must not be tied to the amount of emissions or the consumption of the pollution-intensive good. It must be what economists call "lump sum". A payment can be made that offsets some of the profit or income loss, but the payment should not affect the relative price of pollution. Pollution taxes work by inducing people to substitute activities that pollute less for those that pollute more. Do I drive or walk to the park? The price of gasoline is certainly an important factor in this decision. A pollution tax on gasoline would induce a substitution of walking for driving. If the government then compensates people made worse off by the tax, it must do so in a way that is not dependent on the number of miles driven. Admittedly, it is very difficult to come up with compensation schemes, but not impossible.

Finally, the revenues can be used to "pay" for the cost of the government environmental bureaucracy. Regardless of the instrument used to improve environmental quality, there will be costs of administration. Only the pollution tax — and a marketable permit that is sold, not given away by the government — has the potential to help pay for these costs.

Administration Costs

Taxes should be no more difficult to administer than command-and-control regulations and, possibly, marketable permits schemes. Taxes could be cheaper to administer because they could make use

of existing bureaucratic infrastructure and the tax system. For example, pollution taxes imposed at the retail level could be collected with provincial sales taxes (with provincial approval). Taxes on polluting inputs could be added to the goods and services tax (GST).[7] Taxes could be imposed faster than many command-and-control instruments because of the existing tax infrastructure and because governments have a lot of practice in setting tax rates and what to tax. The basic point is that taxes pose no additional administration costs compared with other policies. Some types of pollution taxes may be simpler to impose and collect than others. Implementation problems still exist — monitoring, compliance, and so on — but these problems apply to all pollution instruments.

Taxes and the Competitiveness of Canadian Industry

Pollution taxes can influence the structure of an industry. If the industry is perfectly competitive to begin with, the introduction of a pollution tax will not discourage competition. Taxation promotes competition, compared with standards that set tighter requirements for new firms than for existing firms and plants. As noted above, taxes can stimulate competition in the search for new pollution control technologies or less-polluting goods.

If an industry is noncompetitive, taxes can influence the number of firms in that industry. This is not unique to taxation, however. Command-and-control legislation, marketable permits, and every other pollution instrument can also influence competitiveness.

The problem is that, when one starts with a noncompetitive situation, there is distortion in addition to pollution. Generally, output levels are too low in noncompetitive industries, compared with outputs that would occur under perfect competition. A pollution tax typically will cut output even more. There is thus a tradeoff

7 The federal government ignored an opportunity to incorporate environmental taxes with the GST.

between the impact of the output reduction on environmental quality (a benefit to society) versus the impact of the reduction on noncompetitive profits (a loss to society).[8] It is possible to find tax rates (on the emissions/output) that do improve social welfare taking these tradeoffs into account. But small changes in the tax rates can lead to discrete jumps in the number of firms operating and, hence, can change market structure. The same could occur with standards or other instruments.[9] A key factor in the impact of taxation (or other instruments) is whether the tax is levied uniformly across the country and across different countries. This topic is examined below. I turn now to the challenges to taxes.

The Case against Taxation

The focus in this section is on arguments opposing taxes specifically, not general arguments against pollution-control instruments.

Taxes Are Unfair

Taxes can create windfall losses for those who cannot at least partially shift the burden of these taxes to others. This is why firms vigorously oppose pollution taxes, which would make many of them worse off. In the short run, their profits would fall. What happens in

8 For a recent analysis of noncompetitive industries and pollution taxes, see J. Markusen, E. Morey, and N. Olewiler, "Environmental Policy When Market Structure and Plant Locations are Endogenous" (Department of Economics, Simon Fraser University, Burnaby, B.C., 1990, Mimeographed).

9 There is an extensive literature on marketable permits and industrial structure. Permits clearly work best when an industry is competitive. See, for example, R. Hahn and R. Noll, *Designing a Market for Tradable Emissions Permits*, Working Paper 398 (Pasadena: California Institute of Technology, 1981); R. Hahn, "Economic Prescriptions for Environmental Problems: How the Patient Followed the Doctor's Orders," *Journal of Economic Perspectives* 3 (1989): 95–114; and the other chapters in this volume. Industrial structure is a complicating factor for any instrument.

the long run depends on their ability to substitute untaxed for taxed inputs and outputs.

Taxes are different from standards or technology requirements of command-and-control policies. They make polluting firms "pay" in two ways — first, for the costs of abating whatever emissions they do control; second, for the tax bill on uncontrolled emissions. Standards — yielding the same amount of emissions control — only impose the first type of payment. This may seem unfair. Any environmental policy can be seen as unfair compared to the status quo, where polluters get to use the environment for free. But this is not an argument that would receive much support anymore.

The fairness issue is thus seen as one where taxes are compared with other pollution-policy instruments. There are several rebuttals. First, the tax may only be "unfair" in the short term, compared with a standard. As noted above, a pollution tax continues to provide incentives to reduce the tax bill and to control more emissions, which a standard does not. If new abatement equipment is cheaper than the present value of the stream of tax liabilities, the firm will install it. There is no analogous incentive with standards.

Suppose the government wants higher environmental quality over time — a goal often established in command-and-control legislation. This requires increasingly tighter standards and often is accompanied by the use of specific technologies for control. Thus the government, not the firm, sets the timetable and determines the technologies. The record on governments' abilities to guess when new technologies will be implementable and how quickly to tighten standards has been abysmal in both Canada and the United States. Support for this statement comes from the record on air and water pollution after the imposition of the *Clean Air Act* and the *Clean Water Act* in the United States, and from the considerable body of ineffectual Canadian legislation. If the private sector really wants to be the best judge of how to control pollution, it should not be opposed to taxation. Taxation may save firms money in the long run.

The second rebuttal is that standards create their own sets of distortions that may be in the interests of certain firms but certainly

not others. If standards are not uniform across all jurisdictions, if they differ for firms based on their location, vintage, or for some other reason, then what is beneficial to one firm, can be unfair to another.

If one really worries about fairness, then, as already noted, tax revenues can be used to compensate losers. It is more difficult to contemplate compensation under standards, for two reasons. First, the revenues for this must come from other (distortionary) taxes. Second, how does one compensate a potential entrant that is blocked by stricter standards imposed on it than on existing firms in the industry?

The arguments against taxation and in favor of standards may be self-serving for all involved. Why else might firms support standards rather than taxes? History suggests that they do so because they know that standards will not effectively constrain their polluting activities. Canadian and U.S. environmental policies are a legacy of unfulfilled promises. Elegant regulations exist on paper that have not been imposed in practice. Tough-sounding standards are approved, then regulators extend the deadlines for meeting these standards. It takes time to develop standards, especially if they are specific to regions and industries. Regulators recognize that some technological requirements cannot be implemented. Firms that "try" to reduce emissions cannot be charged. Legal challenges to standards are common in the United States and even occur in Canada.[10] These actions can keep regulations tied up in court for years.

Command-and-control regulations thus can give the appearance that a lot is being done for the environment when, in fact, the progress is minimal. Regulations look forceful. The U.S. *Clean Water Act* — passed in 1972 and later amended — set up an ambitious timetable for controlling emissions to that country's waterways, the culmination of which was to have been a ban on all deleterious discharges to waterways by 1984. By that time, the United States' water was to be swimmable, fishable, *and* drinkable! Obviously,

10 The company responsible for the "tire fire" in Hagersville, Ontario in 1990 had been fighting Ontario orders to divide the tire piles. The legal system protects polluters while these challenges are being adjudicated.

these targets were not met. Even the interim provisions of the act — to establish specific standards, BATs, and BPTs for each major polluting industry — met with delays and legal battles, and the U.S. federal government did not have the resources to determine these extensive standards.[11] The act received widespread support in Congress, and a cynical observer cannot help but wonder if support was strong because the politicians knew the provisions of the act would not be realized. Polluters are also more apt to support legislation they know will not be effective.

In Canada, much of the federal government's command-and-control legislation sounds as though Ottawa is taking charge, but again, very little has ever been implemented. The *Canada Water Act* (1970) provided for the establishment of regional water-quality agencies, which might have been very useful forces in the control of emissions. Not one has been created. The act also was to have established federal water-quality standards. There are none. In Ontario, pollution regulations for a number of environmental problems have been dealt with by agreements between the provincial government and polluters. Under these agreements, as long as polluters were working toward compliance, they would be allowed to exceed the standards. Finally, in Canada — unlike in the United States — the federal government does not play the major role in setting and enforcing standards. It is beyond the scope of this chapter to examine the complex federal-provincial wrangling over regulatory powers that also characterizes and hamstrings Canadian environmental policy.[12] Simply put, Canada's political system is not well designed to provide for strong federal regulatory powers. National taxes stand a better chance of being implemented.

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11 Ontario's MISA contains provisions very similar to those of the U.S. *Clean Water Act*. One fears that MISA may be similarly costly and of limited success. Market incentives play no role in this policy.

12 Pollution taxes levied by the federal government could cause some difficulty with provincial Crown corporations, notably utilities. Currently, these Crown corporations do not pay federal taxes. Standards do not share this problem.

Taxes Have an Uncertain Impact on Environmental Quality

One cannot predict with certainty what proportion of a firm's effluent will be abated under an emissions tax, nor can one tell exactly how much substitution of environmentally friendly inputs and outputs for pollution-intensive goods will occur with consumption taxes. This means that any given pollution tax rate will not guarantee that a specific environmental target is met. Indeed, some tax critics fear that polluters will simply pay the tax and continue to pollute as much as they did before. There are three responses to this concern.

First, tax rates may have to be adjusted if the reduction in emissions falls short of the target. This means that there is the potential for more tax adjustments than could occur under a system of standards. The long discussion of fairness above suggests, however, that we are far from having ideal standards. If it is difficult to adjust taxes and if achieving a specific pollution target is necessary, then yes, taxes may be less desirable than other policies. Second, recall the incentives for technological change. Over time, emissions will be reduced to a greater extent with a tax than with a standard. But if one needs relatively quick reductions in emissions, a tax may not do the job. Finally, if firms are not abating, the government must be collecting tax revenues. As discussed earlier, they could use these revenues to help improve environmental quality.

Fear of Changing Tax Regimes

The negative side of the previous argument for changing tax rates when emissions reduction is insufficient is that the tax regime introduces business and consumer uncertainty into the economy. If firms and consumers do not know what tax rate they will face, it is difficult for them to plan efficiently. There is also a danger that taxes may become part of another political agenda, thus severing the link between tax rates and emissions. These are all serious concerns, but

they could be mitigated somewhat by requiring government to give parties some lead time before making any changes.

Taxes Drive Out Jobs and Businesses to Untaxed Jurisdictions

This argument can apply to any government policy that imposes costs on firms in a sector that are not borne by their counterparts in other jurisdictions. Pollution taxes are not unique in this respect. And while it is true that tax harmonization — or general pollution policy harmonization — would certainly be preferred to a situation where only one jurisdiction levies the tax, this does not mean that no policy is better than a unilateral policy. What society should be concerned about is social welfare, *inclusive* of the damages to the environment caused by domestic activities, not just the value of production and consumption. Plants, industries, and people may move in response to differential taxes, but social welfare can still increase after the imposition of the tax. There is also no guarantee that these shifts in economic activity will occur. If the tax is a small share of total costs of business, it may affect emissions but not location decisions. Other possibilities exist.

In a framework where two jurisdictions have different pollution taxes, conditions exist where social welfare is enhanced by a unilateral tax even with noncompetitive firms.[13] Under certain tax rates, economic activity can even increase. For example, a pollution tax imposed in Canada but not another country — say, the United States — can deter the entry of a foreign firm, while the Canadian firm does not shut down. It also opens an additional plant in the United States because of the lack of taxes there. Domestic employment does not decrease, and Canadian incomes are higher because there is less pollution and because there are larger returns to the owners of the Canadian firm. The tax policy becomes a barrier to entry, and while this inhibits competition domestically, it reduces emissions and

13 See Markusen, Morey, and Olewiler, "Environmental Policy When Market Structure and Plant Locations are Endogenous."

increases welfare. Other results are also possible. The point is that the "drive out jobs" argument may simply be false in a framework of trading regions or countries.

Taxes can also create jobs and general income. As noted before, the search for cost-saving technologies for abatement may spur economic activity. Green products, recycling, and less waste creation can be good business. The pollution tax helps this process along by providing financial incentives.

Why taxes? Why not? There are no arguments against pollution taxes so compelling that taxes do not warrant serious consideration in the policy arena. Self-interest should be recognized as a motive for opposition. Taxes share many practical difficulties with other policies; these difficulties have been articulated by many and are not repeated here. The point is whether or not we want to see improvements in environmental quality. If the answer is yes, then taxes should be considered along with the other policies.

Governments can no longer afford to ignore the benefits of taxation for fear of alienating special-interest groups. In the current political environment, the federal government has an opportunity to consider pollution taxes seriously in its Green Plan. Tax may be a dirty word after the GST, but these taxes are different. They are benefit taxes, in the sense that people are being asked to pay for the costs they impose on the environment and the costs of cleaning up the mess. Standards have a poor track record. They take a long time to promulgate, are often very ineffective, and are expensive for the economy. Finally, other countries are rediscovering taxes. Pollution taxes are a major agenda item for European economic integration. The United States is talking — perhaps seriously this time — about pollution taxes on energy inputs. Canada could be a leader, not a follower, in this process. Even if Canada were to go it alone, the gains could outweigh the costs.

When and What to Tax

Pollution taxes are appropriate for specific environmental problems, but not for all. No single instrument is appropriate in every case. The

list below is not exhaustive, but suggests the characteristics of the type of environmental problem conducive to taxation. I conclude with suggestions for some specific taxes.

Conditions Conducive to Taxation

First, marginal changes in the level of pollution will increase environmental quality. It is not necessary to have predictable explicit changes per unit time. There is no threshold level of emissions beyond which catastrophic damages to the environment occur. If these conditions are present, the uncertainty associated with the impact of a pollution tax on emissions will not be a major concern.

Second, the time of release of emissions and their precise location is not crucial to environmental quality. This suggests that a uniform tax could be used to improve environmental quality. If taxes must be tailored to specific locations and times of day, then they become very difficult to implement, just as with individual standards. If uniform taxes are used when the impact of emissions on environmental quality differs across regions, "hot spots" of severe environmental degradation can occur. This may still be preferable to individual taxes. If hot spots occur, taxes could be used in conjunction with other policies, such as standards.

Third, the tax is more effective and generates fewer windfall losses when supply-and-demand curves for pollution-intensive products are neither perfectly elastic nor inelastic. Taxes would also generate fewer losses if the sources of emissions are many and each produces similar amounts. That way, tax rates can be relatively low and still elicit reductions in emissions.

Fourth, efficient tax rates can be set more precisely if the government has good information about the nature of environmental damages on the margin. If damages per unit pollution emitted are relatively constant, then tax rates can be set with less information about the polluters' costs of control.

Finally, taxes can be combined with standards and can act as penalties for noncompliance.

Possible Taxes

Given these characteristics, what are possible candidates for pollu
tion taxation?

Fuel Taxes

The combustion of coal, petroleum products, and natural gas emi
a variety of by-products that can adversely affect environmenta
quality. These include sulfur dioxide, unburned hydrocarbons, ni
trogen oxides, and of course, carbon dioxide. As well, the component
of combustion form photochemical smog and ozone. Some of th
environmental problems arising from combustion are global (warm
ing from carbon dioxide), others are local (ground level ozone). Th
relationship between combustion and emissions is well known b
scientists, while the link between emissions and environmenta
impact is less certain. Would a tax work in this case?

I would argue for national pollution taxes on all fossil fuels
including uranium.[14] A uniform rate could be set for each fuel type
depending on the environmental characteristics of the emissions
There are large numbers of emitters of all the pollutants, eac
contributing a small amount. The tax would be easy to administe
and to collect, and need not be confiscatory. While there would b
some short-term rigidities, these would dissipate over time as con
sumers and producers respond to the price increase. The "energ
crisis" of the 1970s is evidence of the elasticity of both supply an
demand in energy alternatives and substitute products.

The tax need not be based on any single pollutant, thus avoidin
the difficult determination of marginal costs of control versus dam
ages for each user. The tax would increase environmental qualit
directly and even more so if the revenues were reinvested in th

14 For other discussions of fuel taxes, see D. Dewees, *Evaluation of Policies f*
Regulating Environmental Pollution, Regulation Reference Working Paper
(Ottawa: Economic Council of Canada, 1980); and W. Oates, "Markets f
Pollution Control," *Challenge*, May–June 1984, pp. 4–17.

environment. This is not a carbon tax *per se*, but a broader-based tax on the consumption of fuels.[15] Other pollution-intensive inputs might be similar candidates for taxation — for example, pesticides, herbicides, and solvents.

Pollution Taxes on Commodities

The federal government already taxes one consumer good responsible for an environmental problem — automobile air conditioners that contain chlorofluorocarbons (CFCs). The motive for the tax was to raise revenue with an excise tax on a luxury good, but there is no reason why this tax and others could not be imposed on consumer goods responsible for environmental degradation. Some of these types of taxes already exist in certain provinces. British Columbia has additional taxes on tires and car batteries, and removes provincial sales tax on environmentally friendly goods such as bicycles and certain energy-saving home improvements. Again, we are talking about diffuse environmental benefits and damages. These are cases where taxes can work well. They change the relative prices of goods, and people respond by substituting away from these goods.

Conclusion

Taxes are a neglected instrument in the process of environmental policy. They have not been extensively used by governments. This chapter has examined the case for taxation and addressed some of the concerns of those who are opposed to taxes. Taxes are not a general solution, but could be used to reduce the output of pollution and to generate revenues that, in turn, could be used to improve environmental quality. I repeat the appeal for benefit taxation. If taxes are tied directly to the environment, the opposition to them should weaken and the scope for government mismanagement (and

15 The United States is currently considering a tax somewhat similar to this.

hidden agendas) should diminish. Command-and-control legislati
has had limited success in improving environmental quality and h
done so at costs that are higher than necessary. We can no long
afford to ignore pollution taxes.

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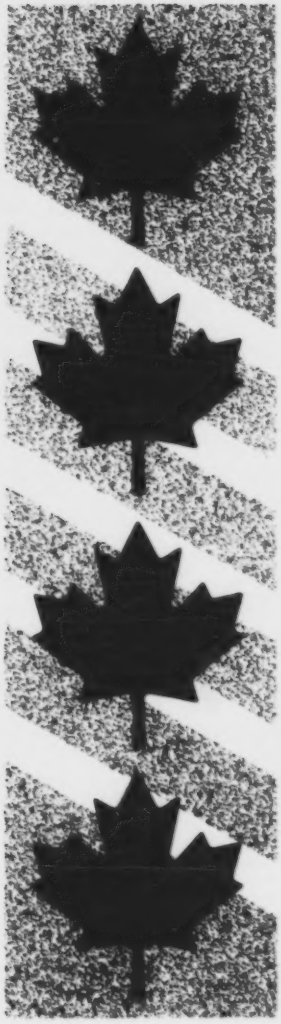

GETTING IT GREEN:

Case Studies In Canadian Environmental Regulation

edited by

G. Bruce Doern

Canada's environmental problems are commanding increasing attention in this last decade of the century. Traditional regulatory approaches have been less than satisfactory, however, and policymakers increasingly will have to use market-oriented approaches – such as tradable emissions permits and environmental taxes and charges – if these problems are to be tackled successfully.

Government still has a vital role to play in setting emissions-reduction standards and in the tasks of monitoring and enforcing compliance. But what is needed now is a new partnership between traditional regulation and market-oriented approaches. ***Getting It Green*** is the first Canadian study to examine these issues through specific case studies of methods used to combat several major pollutants.

G. Bruce Doern is Professor of Public Policy at the School of Public Administration, Carleton University, and Scholar-in Residence at the C.D. Howe Institute. His recent publications include ***The Environmental Imperative: Market Approaches to the Greening of Canada*** *(1990)*, and ***Privatization, Public Enterprise and Public Policy in Canada*** *(1988)*.

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